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AMERICAN MACHINIST

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Combination Turret Lathe.

We illustrate on this page and page 2 what is termed by the makers a Combination Turret Lathe. It is for making screws and studs of all kinds up to 2″ diameter, and for general work.

It is quite a large and heavy machine, swinging 20″ over the ways, 11½″ over the carriage, and weighing, ready for shipment, 4,500 lbs.

The machine is chiefly remarkable, however, for its completeness, the large variety of functions which it is capable of performing, and the evident care and attention which have been given to the designing.

As will be seen, it is capable of performing all the operations usually performed by a screw machine; having a 2⅛″ hole through the spindle, which has a chuck fitted at each end; a three-stepped cone for 4″ belt, the largest step 14 inches in diameter, with back gears proportioned 4½ to 1, and a six-hole turret, with automatic or hand feed. The back gears are thrown in or out of action by means of a friction clutch, which is operated by the lever shown on top of the main bearing, and by means of which the machine may be instantly stopped, or the back gear thrown in or out without stopping. The proportion chosen for the back gears is with a view to providing the proper ratio between speeds used for removing stock, and those for running on dies or tapping. The holes in the turret are 2½″ diameter, and the turret is hexagonal in shape, the object being to provide flat surfaces to which tool holders or other devices may be bolted, as is sometimes preferred.

The turret slide has a motion of 14″ in the block, with an adjustable trip for the automatic feed.

The feed mechanism is clearly shown in the rear view of the machine, page 2, where it will be seen that it is geared in such a way as to give a very powerful feed. The turret revolves automatically, as it is drawn back or not, as may be desired; the change being made by simply pushing in a small pin in front of the slide.

Instead of the usual block with cut-off slide, a regular carriage is provided, which is handled in the same manner, and, in fact, is essentially a lathe carriage; having an automatic feed along the bed, and an automatic cross-feed. An adjustable stop is provided with which the carriage may be brought into contact when it is desired to bring it to the same position for a certain cut upon each piece, and it may also be clamped in any desired position upon the ways, when the cross-feed is to be used.

There are also adjustable stops for limiting the motion of the cross-slide in either direction. The cross-slide carries two tool blocks, which may be adjusted to any desired distance from each other. The motion of the feeds is reversed by means of the bevel gears and double-ended clutch, shown in front under the cone pulley. The clutch is operated by the handle above.

An unusual feature for machines of this class is seen in the provision made for turning tapers, which is done by means of a Slate taper attachment, shown by the rear view, page 2, which also shows the arrangement of the chasing-bar, which is perhaps the most novel feature of the machine.

Into the brackets which support the back gear are fixed two sleeves or thimbles, which project inside the brackets, each toward the other. They enter the ends of the back gear quill, which is enlarged for the purpose; the two forming the bearings for the back gear. Through these sleeves passes the chasing-bar, instead of being provided with independent supports; the whole making a very neat and compact arrangement. The stud, upon which is placed the chasing hobs, runs at half the speed of the main spindle, which gives an opportunity for the employment of coarse, and, consequently, durable threads, which are made of the buttress or ratchet form. The arm which carries the nut is adjustable upon the bar, and is clamped by the two bolts, as shown.

To the other end of the chasing-bar are fitted two castings, one of which is the hand lever for operating the bar, to which it is keyed fast. The other piece has two bearings upon the bar, one each side of the lever, under which it passes, and is provided at one side with the chasing tool slide rest. This piece is not keyed fast to the chasing-bar, but is made to turn freely upon it, being, however, secured to the hand lever by the single bolt seen passing down through a boss, in the center of the lever. The bolt passes freely through the lever, and is tapped into the lower casting. Around the body of this bolt is a spiral spring, which tends to force the two pieces apart; and when the bolt is slacked it does so to any extent desired.

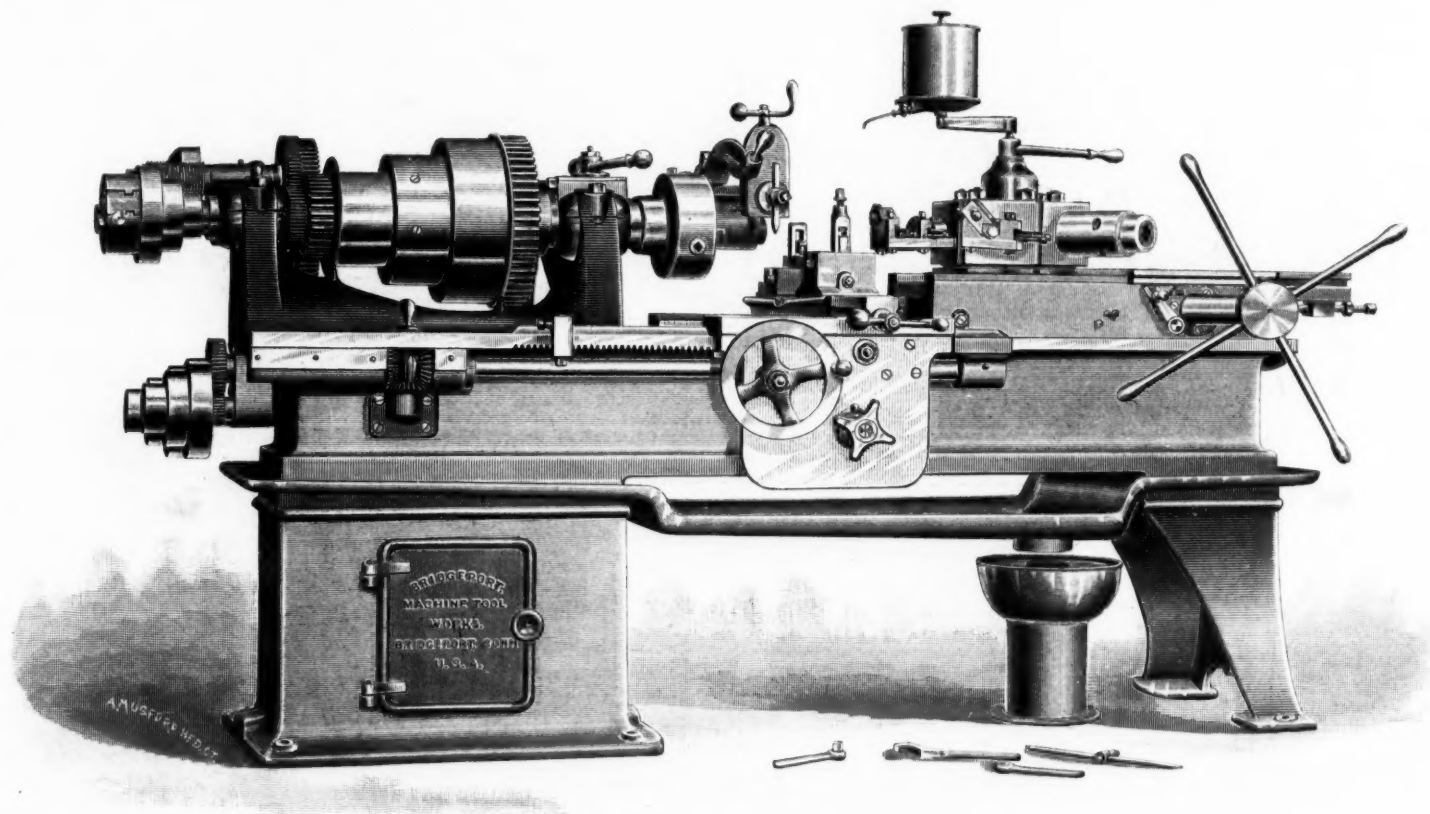
Underneath the lower casting is a guide bar, upon the upper edge of which it may be made to rest; and which may be inclined either way, to any desired amount. Supposing the bolt to be slacked and the spring to have the two pieces separated a short distance, the bar may be swung over by the lever, until the piece carrying the tool rest is in contact with the guide bar. A further depression of the lever does not lower the tool, but compresses the spring, and, at the same time, brings the nut into contact with the hob; then, as the bar moves along, the spring extends and keeps the lower piece down upon the guide, which, as said above, may be set at any desired inclination.

Thus is solved, in what seems a very ingenious and practical manner, the problem of producing taper threads with the chasing bar, and yet keeping the nut and hob fully engaged.

It will be seen from the above that the machine embodies many new features, and is capable of performing work which we think has never before been attempted upon a machine of its class.

The countershaft has three friction pulleys, 16″ diameter for 4″ belt, thus giving two speeds forward (75 and 150), and one speed backward (150).

The machine is built by the Bridgeport Machine Tool Works, Bridgeport, Conn.



COMBINATION TURRET LATHE.

Scrap Iron and Scrap Ideas.

BY FRANK RICHARDS.

One of the bad habits of the machine shop—not the less bad because it is nearly universal—is the accumulation of worthless material. There is scarcely a shop in the country that is not guilty of it. The first sign of the standard machine shop, when you come near it, is the worn-out, worthless, rusting stuff scattered around the yard. With many it accumulates so inveterately, that nothing but financial embarrassment will do anything towards reducing it. I know that in one shop, when they began picking up the scrap, the boys used to begin to remark: "The old man must be going off on a trip, and he's trying to raise the wind."

There is not merely the actual and accepted scrap heap, which continually needs sorting over, and a resolute melting or selling off, to keep it down, and then the big, ugly pieces that we lean against the wall all around, the balance wheels, and the gears, and the crank-shafts, and all that; but there is, besides

that, and probably worse than that, a crowd of old tools, old machines, ingenious contrivances for special jobs, things of all kinds that in their day have cost time, and thought, and skill, or have done good service, and that it is heart-breaking to part with. But what things once cost has nothing whatever to do with their present value in the machine shop; yet it is hard to enforce the fact. What good things may have done, or what money they may have earned in other days, is not much better as a measure of their present value.

It is, after all, not to be wondered at, that the machinist hates to destroy what has cost so much. His appreciation of the value of good work, of good work in his own line, is very touching. It is an expression of his self-respect. A mechanic who has put his best thought and skill into a piece of work is apt to look upon it with positive affection. So the accumulation of scrap in the machine shop is the result of a feeling that is not to be despised. All the same, that does not make the fact of these accumulations anything but a nuisance, a hindrance, a constant damage and expense.

There is nothing like having plenty of room in the machine shop—room to get around, room to get at every part of lathes and machines in use, room to work comfortably on every side of a job in progress, room to let a job stand undisturbed in its place until it is finished, instead of setting it up and pulling it down, and shoving it around, to accommodate some other job. Sometimes, in looking over a shop which was the boast of its enterprising proprietor, where tools and facilities were liberally provided, I have been moved to say: "Yet one thing thou lackest." A little money invested in more room would have paid better than any other expenditure connected with the establishment.

But room used for the other purpose of accumulating stumbling-blocks, whether for the feet or for the head, is a blessing transmuted to a curse. Old tools, old machinery, old material generally, have a most damaging effect upon the mind, the habits, the methods of the machinist proprietor. The actual pecuniary loss in the carrying a mass of unproductive material is small in comparison with some of its collateral evils. The constant incentive to work in and get rid of worthless stuff, fosters one of the fatal habits of the machine shop, and many have died of it. There is bad faith, if not actual dishonesty toward the customer, in sticking on him what is not the best, and, in the long run, however obtuse he may be, he begins to find it out, and goes elsewhere. The machine designer of the present, who has to step in the old footsteps, is necessarily in a false position, and is facing the wrong way. The essential condition of progress is to be always seeking the best, or at least something better. Temporizing is the precursor of surrender.

What a habit the machinist has of treasuring patterns that are old, but not venerable. They have had their day and have paid their way; but, because they were worth so much once, it is so hard to part with them now. They are carried along, and a heavy insurance on them, when the pattern left may be as truly a scrap-heap as the pile of old castings out by the cupola. There is nothing existing that can be sold to the insurance companies so advantageously as old patterns. All that can be realized on them in that way is clear gain. About the most absurd advertisement I know is that of "A machine shop for sale, with a valuable stock of patterns." If a fire could sweep over the land, and destroy every existing pattern from five years old and upwards, there would be wailing and gnashing of teeth in the mechanical world, but the machinery product of the country would be greatly improved. We would have many new as well as many better machines. Scarcely a thing existing but would arise from the fire better and brighter than before. A tailor is looking for a chemical preparation that he can dip his clothes into, and fix them so that they will remain intact for a year and a day, and then go all to pieces. We need something of the same kind for the machine shop.

It is useless to say that there are scrap habits of thought, scrap methods and practices in the shop, of which the old iron scrap heap may be taken as typical. It will be well to go over and examine all the places where scraps of either of these several kinds have accumulated, and resolutely throw them out.

Shop Notes.

During a recent call at some of the tool shops of Philadelphia, we found business generally good, with prospects for improvement in the future.

The first thing seen on entering the shops of Bement, Miles & Co., was the end of a steel shaft sticking through a recently-made hole in the brick wall separating the machine shop from the stairway leading to the offices.

This shaft was slowly revolving, and, upon investigation, proved to be a steel screw for a lathe which they are building for Cramp & Son's shipyards. This lathe is somewhat remarkable for its length, being a 50″ lathe, 68 feet long.

The screw is of steel, 2⅞″ diameter in the rough, and 67′ 4″ long. They had some little difficulty in securing the bar; but finally it was furnished by the Pennsylvania Steel Company. Amongst the other new tools in process of construction, we noticed a plate planer for the Norfolk Navy Yard, which will plane 18 feet at one setting. At one end, the bed is extended at a right angle, and upon the extension is placed a slide, carrying a screw-driven saddle, for planing the end of the plate at the same time. The slide can be swung around each way from the central position, to plane the end of the plate, either at an acute or at an obtuse angle with the side being operated upon. Two of these machines are being put in at Norfolk.

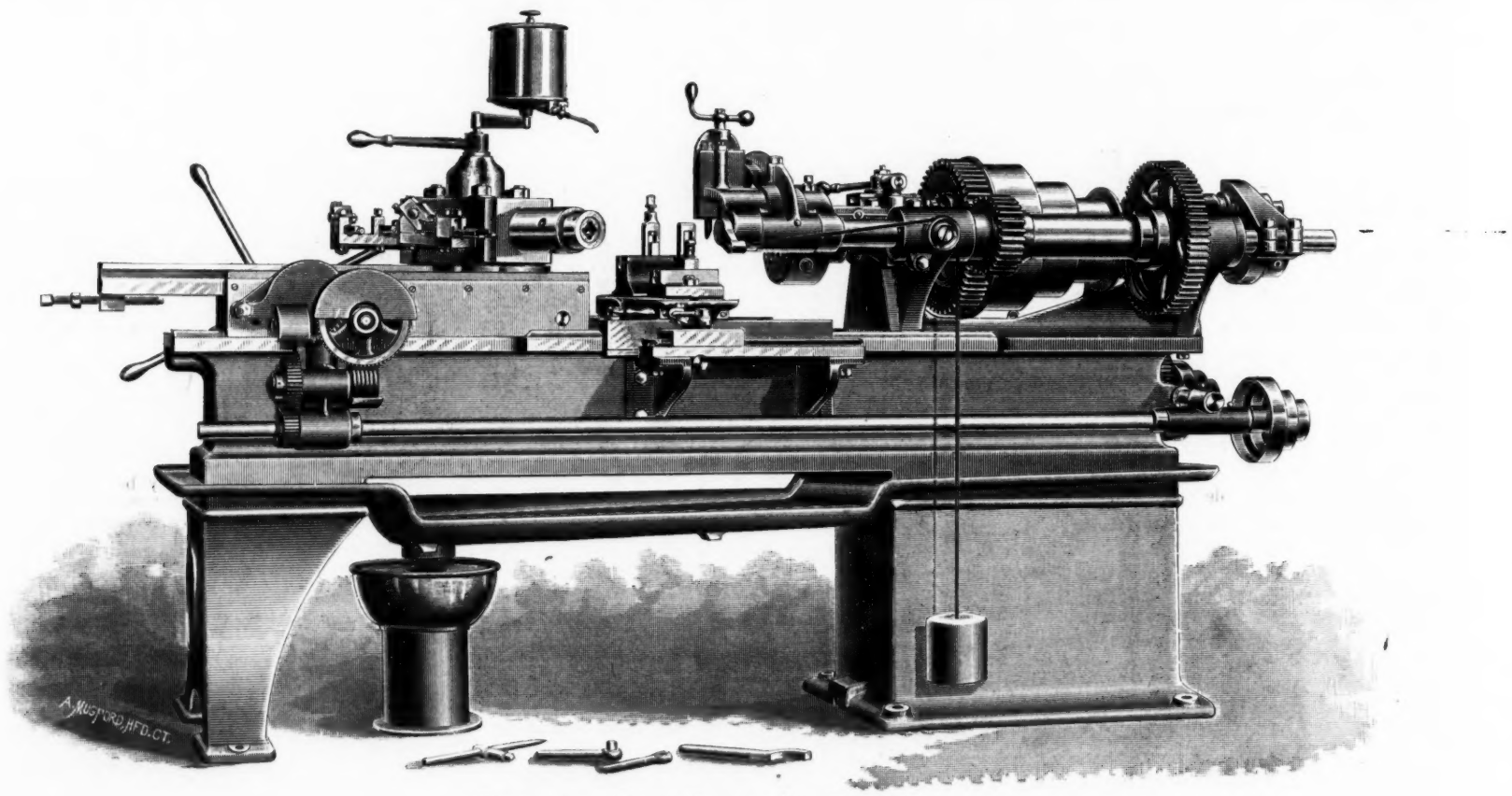
Drawings are being made for a lathe to be built to the order of the Government for 6″ guns. A great deal of grinding is being done in these shops in finishing cylindrical and conical surfaces of parts composing their tools. All the shafts, spindles, bearings of screws, lathe centers, etc., to which the process is applicable, being finished by grinding in Brown & Sharpe universal grinders instead of in the lathe as formerly, the process giving them excellent satisfaction.

A tool in use in the shop, which is apt to attract the attention of a mechanic, is one which they call a wall planer, not because it is a wall planer, but because the idea is taken from a tool used in England, known by that name. The English wall planer consists of a vertical slide, upon which is mounted a saddle driven up and down the slide by a screw. The slide is supported by the wall of the building, from which circumstance the name is derived. The work to be operated upon is fastened to a large bed-plate, which is level with the floor, and stationary; feed motion being obtained by lateral movement of the slide along the wall, to which, of course, the proper supports and ways are fastened.

It is easy to see that such a tool would have certain advantages for heavy work, and, perceiving this, the tool in question was constructed. Like its English prototype, it has a vertical slide carrying a saddle, but this slide or upright is made independent of any wall, being supported upon slides at the bottom sufficiently heavy, and separated from each other a sufficient distance, to give it the required rigidity. It has a motion along these slides by a screw, which can be given a small intermittent movement for feeding, or can be given a more rapid and powerful alternating motion by belts and gears, for driving the upright horizontally when so desired. The cutting is thus done horizontally instead of vertically, the screw in the upright being at the same time given a motion proper for feeding. The same changes can be made with the screw in the vertical slide, and thus the motion of the cutting tool may be either vertical or horizontal, the feed motion being at right angles to it in either case. It is little trouble to make the changes—much less than to turn a heavy piece of work over, as would often be necessary if the cutting stroke was always in one direction. A mechanic watching the machine at work is likely to wonder why such machines are not more generally used; it would seem as though there is a field for them on heavy work, which is difficult to handle, and for operating on the ends of very long work.

In the foundry they are trying a novel experiment in lighting with gas. All around the walls, and about 8 feet from the floor, runs a line of 1″ and 2″ pipe, and to this, about 18 inches apart, smaller pipes are connected, which have at their ends gas burners. The effect is very pretty—somewhat suggestive of a torch-light procession—and gives a very good general illumination at a cost considerably below electric lighting.

Since the consolidation of Wm. B. Bement & Sons and the F. B. Miles Machine Tool Works, the shops of the latter are devoted mainly to the building of steam hammers,



COMBINATION TURRET LATHE.—SEE PAGE 1.

most of the tool-work being done in the other shops.

A horizontal boring machine, built in the shop and used for boring and other operations necessary in the building of steam hammers, is worthy of note, on account of its unusual size and the variety of functions performed by it. It consists of a massive bed set in masonry, upon which is mounted two uprights, one carrying the boring bar with its necessary driving and feed mechanisms, the other, which is movable along the bed, being provided with a saddle upon which is the support for the outer end of the bar. The saddles carrying the bar and the outer support move up or down together upon the uprights, the screws which move them being connected by suitable gearing. The extreme height of the bar above the table is 72 inches. The table, which is about 8′ square, is between the uprights, and has a movement along the bed; a cross movement of 9′, and a circular movement by which it can be revolved completely around upon the bed; all these movements being either by hand or automatic for feeding, and conveniently con-

trolled from the front of the machine. The bar may be fed through its supports 3′ continuously, and its total movement is 8′. The spindle is 5″ diameter; total length of the machine, 22′ 4″.

The various motions which can be given to the table and spindle make it capable of doing a large variety of work, using drills, boring bars, or milling cutters, and a heavy piece of work, such as one of the pieces composing the frames of a large steam hammer, can be fastened to the table, and holes bored or drilled parallel or at any desired angle with each other, and milling operations performed upon any surface except the one which is down upon the table.

Considerable interest is taken in this shop in the matter of fine levels, straight-edges, and surface plates, some specimens of such work recently completed by Mr. Speaight, who has charge of the tool room, giving evidence of the highest grade of skill and inexhaustible patience.

It is here that the spirit levels illustrated by "Jarno," in our issue of April 28th, were made. A surface plate, 3′ 8″x2′ 2″, one of three original plates, is as fine an example of such work as one could wish to see, both as regards its accuracy of surface and beauty of scraping.

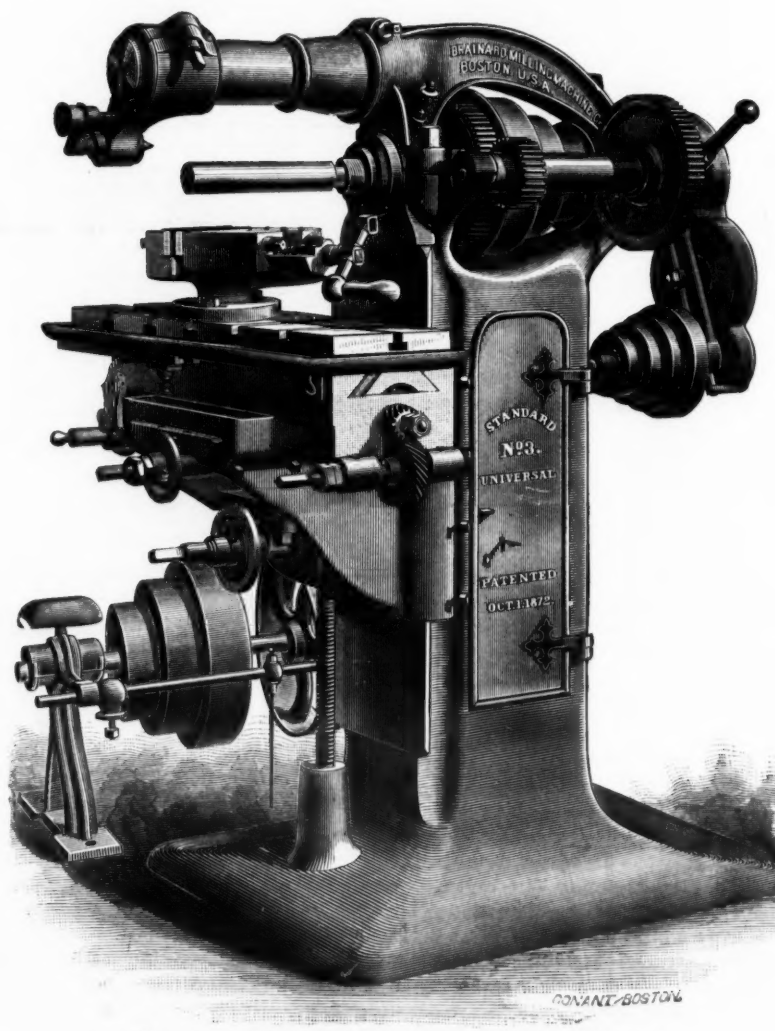
At Wm. Sellers & Co's. shops they are employing about 500 men on tools and power cranes, their business in the latter, especially, being rapidly on the increase. Amongst the tools noticed, in process of building or ready for shipment, was a plate planer for the navy department, to plane plates 22 feet long at one setting, and at the same time one end of the plate up to 5 feet in width, square or inclined. Provision is also made for a vertical feed motion of the tool for planing flanges up to 9″ high. Some tools were being shipped to Cuba, to be used by the Spanish Government in an artillery shop, for which they have furnished a plant, including planers, punching and shearing machinery, hydraulic riveting plant, and plate planers.

The tool grinding machine which we illustrated in our issue of Aug. 13th, 1887, is proving in use to be all that was expected of it, and no mechanic, witnessing its operation, and seeing the results achieved by its use, can fail to be convinced of its great utility as a means of improving the quality and cheapening the cost of the products of machine shops. It seems to be capable of grinding any tool of almost any conceivable shape, and a surface or line upon that tool intended to be straight will be straight, and at just the desired angle to any other line or surface. A curved surface or line will have just the curve intended, and every time the tool is ground, these conditions will be preserved or restored with infallible accuracy, and the exasperating and seemingly inherent tendency of what are intended to be flat surfaces, and straight lines, to become complex curved surfaces and lines when ground by hand, is entirely avoided. It seems to be especially valuable in grinding tools for cutting threads of various shapes and the nuts to fit them; also for flat, broad tools used for finishing-cuts in the planer. One man runs the machine and does all the grinding, turning the tools into the tool-room, from where they are taken by the men upon checks, the same as other tools. The cost of grinding is thus reduced to a small fraction of its cost when done by hand, and the men, being relieved of what is always an unpleasant and usually a slighted task, and having tools always ready for use, ground in the best possible shape, are pleased with the innovation, and would very reluctantly go back to the old way. All tools are ground to a standard form, which has been adopted as representative of the best practice of the best mechanics in that shop, and thus the highest degree of efficiency is secured for every tool during its entire existence, instead of for an occasional tool for a part of its existence.

An objection which might be urged against the use of such a machine is, that it has a leveling tendency, which may prevent the best mechanics from reaping the full advantage of their superior skill in shaping and grinding tools. One of the chief reasons why a good mechanic can do better work, and more of it, on a lathe or planer, than a poor mechanic, is that he can grind tools to a better shape, so that more work and better work can be done with them than the inferior mechanic can do with his inferior tools, and it is questionable, whether or not the ambition and study necessary to secure this advantage can be expected where no advantage to the superior workman can be secured by it.

There are many shops where, if there is ever a properly shaped tool, it is more the result of an "unintentional accident" than anything else, a machine would perhaps help to crystallize the bad practice of such a shop, and prevent the influence of a good workman, who might subsequently be employed in it, from being felt.

But, whatever force there may be in such an argument, it applies to comparatively few tools, since the large class of tools, regarding which there can be and is but little difference of opinion, or of practice in the grinding, is the very class in which the superiority of the machine is most manifest. It would, of course, devolve upon the management of a shop introducing such a machine, to see that the leveling process is a leveling up, and not a leveling down. Whether or not this is the best possible machine for the purpose, is of course yet to be determined; but until its builders or some one else improve upon it, it will, of course, be considered so; at any rate, no mechanic, we think, can witness the results obtained by its use in these shops without being convinced that it is very ingeniously and well designed, that there is a field for such a machine, and that its advantages over hand grinding are great.



IMPROVED BRAINARD UNIVERSAL MILLING MACHINE.

Wm. Sellers & Co. are just taking the initial steps in what is intended eventually to be a complete substitution of new buildings for the old, the foundations now being prepared for a new erecting shop 60x143 feet, which is to be equipped with their traveling cranes and all other modern appliances. A new machine shop of about the same size is also to be built, the heavy tools in which are to project into the erecting shop, to bring them within reach of its cranes. These buildings are to be of brick, one story high, with iron framed roofs.

Pedrick & Ayer have outgrown their quarters, and have now under way the plans for a new shop building, which is to be built in the spring, 40x160 feet, two stories high, with walls sufficiently heavy to admit of additions skyward should they be required. It is to occupy their present site, and have all modern improvements. They have recently been putting in a number of new tools, but it is evidently impossible to put in any more of them until their new shops are completed. They report business in their specialties for railroad repair shops and milling machines to be as good as could be desired.

Improved Brainard Universal Milling Machine.

The machine which we illustrate herewith, while it is essentially a standard Brainard machine, has yet been modified in dimensions, and some improvements added to make it more especially adapted to tool-room service, the principal change being the placing of spiral gears at the end of the table for moving it by hand.

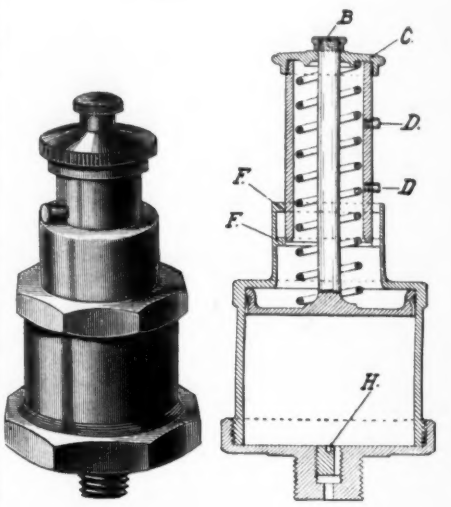
The special features of the machine are of course familiar to our readers, it being therefore necessary to mention here only the principal dimensions, in respect to which it differs from the others, for the purpose specified above

Mills can be used from the smallest up to 8″ diameter, and it will mill 13″ from the face of the machine. The table has an automatic feed horizontally under the spindle of 20″, a vertical adjustment of 18″, and a cross motion in line with the spindle of 5″; these latter motions being, as usual, graduated by thousandths of an inch. The T-slots in the table are milled to standard gauge, pains being taken to make them exactly parallel to and square with the face of the machine. The overhanging arm is easily removable in case it is not needed.

The feed worm and feed gearare of hardened tool steel, feed screw of steel, and all other screws of steel or iron case-hardened. The feed nut and the bearings of the spindle are compensating. The spindle has a $\frac{9}{16}$″ hole through it, and is threaded in front, so that the same chucks or other devices which fit on the spiral cutting attachment and universal head will also fit the spindle. A dust cap is provided for the front bearing.

The weight of the machine ready for shipment is 2,200 pounds. Fast and loose pulleys, 12″ diameter, 3½″ face; revolutions of counter-shaft per minute, 120.

The machine is built by the Brainard Milling Machine Co., Hyde Park, Mass., the general selling agents being Hill, Clarke & Co., Boston, Mass.



The Lackawanna Grease Cups.

We illustrate by the accompanying cuts, a cup design for the positive feeding of grease to journal bearings. The use of copper wires which transmit heat from the journal to the grease, causing it to be fed as oil, is dispensed with, and the action of a packed piston, forced down by a spiral spring substituted.

The cut, Fig. 1, shows the general appearance of the cup, and Fig. 2 is a section showing its construction.

The spring is made long and powerful enough to secure practically uniform pressure, and, consequently, uniform feeding from the beginning until the cup is empty; varying only with the speed of the journal, and stopping when the journal stops. With the lubricating compound recommended for use in the cup, the feed is claimed to be uniform under all ordinary variations of temperature, also. The method of compressing the spring with a screw has been discarded, because it is slow in operation, and when a cup has been emptied, the operator must screw the piston all the way back before he can refill. By the present method all adjustments are made by a single movement. Owing to the fact that a closely packed piston is employed, which cannot be readily removed from the cup every time it is to be filled, the cup is made to open at the bottom for re-filling. The sectional cut shows the parts in the position they assume when the cup has just been filled, and before the spring has been compressed to commence feeding. This compression is effected by forcing down the hollow handle which encloses the spring, until the lower stub *D* passes through a notch provided for the purpose, and turning it slightly to make the stub engage the under side of the first, or upper flange. This leaves the piston rod *B*, standing above the cap (*C*) of the handle, and it then becomes an indicator; the distance between the caps *B* and *C* indicating the depth of grease to be expelled before the operation will be suspended by those parts coming into contact. The fact of there being two stubs and two flanges, with a varying distance between them gives four points at which the handle may be set; but where a longer run without attention is necessary, as, for instance, is often the case with crank-pins, the lower stub may at once be engaged with the lower flange, and the cup emptied in two settings.

The screw for regulating the feed is shown at *H*, and is a simple, plain screw, with a notch in one side of it, through which the grease is forced to the hole which passes through the shank. By screwing it down, the hole is choked more or less, to regulate the feed.

The piston being packed, the grease is prevented from getting above it and interfering with the action. The piston rod *B*, is in the larger sizes, made of tubing, to reduce the weight. The spring is of a special phosphor-bronze wire. It is evident, from the construction, that the cup will act equally well in any position, horizontally, or even upwards from below.

These cups have been tested in a number of trying positions where trouble had been experienced in securing thorough and reliable lubrication, and have given excellent satisfaction. They are made in six sizes, by The Lackawanna Lubricating Co., Scranton, Pa.

Design, Construction, Repairs and Management of Marine Steam Engines and Boilers.

BY W. H. HOFFMAN.

TWENTIETH PAPER.

When Mr. Rowan, the well-known English engineer, built his first compound marine engine, he set two rectangular cast-iron flanged frames athwartships, with the crossheads working at right angles to the direction usually adopted at the present day. This design appeared only in his first engines, as it was wholly unsuited to marine service. This style of frame, very much modified and improved, has been and is now frequently used by our American marine engineers, and is often called the A frame, because it resembles the form of the letter A, with a very wide top.

Sometimes it has two or three cross-bars, according to its height. It makes a strong frame when properly flanged, and is very easy to cast, as there are no cores used, but, in adopting this design, the crosshead must be placed in a fore and aft direction, and this is, therefore, expensive.

In 1857, James and George Thompson, of Glasgow, built engines with what is sometimes termed the steam hammer frame, but generally designated as the vertical girder frame. These frames had deep webs and wide flanges, and were much heavier, in proportion to the work, than those built by the same firm at this date. They, as well as other marine engine builders, have studied the distribution of metals since then, and a fair illustration of their improved and new designs are the frames of the engines of the new steamship "City of New York."

Hollow cylindrical columns of cast-iron were among the earliest designs for vertical marine engines, and this year a new English steamship has been fitted with engines of 6,000 horse-power, the frames of which consist of six plain cylindrical cast-iron columns, with circular flanges at each end, fastened with numerous bolts to the bed-plate and cylinders.

A design, commonly used at this date by many marine engine builders, has a tubular cast-iron frame of a rectangular section on one side of the bed and cylinder, and a turned wrought-iron or steel column on the other side. The cast-iron column in this design is frequently used as an exhaust pipe leading to the condenser, and, with engines running in fresh water, it is sometimes used as a jet condenser. Another advantage claimed for this combination design is that, by using the small wrought columns on one side of the engine, the attendants can always reach the main running gear readily in case of heating.

Then there is the semi-tubular girder frame, open toward the shaft, or center of the engines; but these frames have not met with much favor as yet, as they do not appear to have the requisite element of stiffness, unless an excessive amount of metal is used.

I have seen two marine engines with wrought-plate frames thimbled together, and the crosshead working in guides between them, but these uprights were also lacking in stiffness.

The English torpedo-boat builders have (as previously stated in another paper) made wrought frames by bending iron and steel plates over cast-iron frames, but these were very unsatisfactory when under full load and very high speed.

The strokes of vertical marine engines for screw propulsion have been materially increased during the past eight years, and, as a result, the upright frames are much higher than they formerly were. Then, again, the number of revolutions per minute have been increased, even with the increase of stroke, so that many marine pistons travel 800 feet per minute; a speed considered impossible for either vertical or horizontal screw propelling engines, a few years ago.

I do not propose in these papers to condemn the design of any engineer, and shall therefore make no extended comments on the several designs of upright marine engine frames enumerated above. I will say, however, that I have not covered more than one-third of the various types of upright frames, but think I have covered the best of them, with one exception, and that design has stood the most trying and exacting tests for the past eighteen years. I refer to the rectangular tubular split or double-footed girder frame now in use in the finest ships in the world.

Some of the designs of this upright are not without their faults, because some engineers try to make them too light, counting too much on the natural great strength of this form of girder.

The most common mistake made by the draftsman in laying out this style of girder, is the making of the lower double portion of the girders too short, thus leaving a slender stem above, to receive the cylinders. The girders should split well up, at least two-thirds of the height, and the spread of the lower portion, in a fore and aft direction, should be as great as the distances will permit. This method, "touching" at each joint or section of the division of the girders, tends to brace and strengthen the whole structure, especially at the junction of the upright girders and the bed-plates, where the transverse strains at times are enormous. There will be plenty of room to pass between the legs of each set of frames, as the lower floor plates will be set about 12" above the top face of the main bed-plates, and 22" above the center of the shaft. These plates will be in small sections, so that they can be easily removed.

A member of the New York Stock Exchange was caught a few days ago in the act of evading payment for his noonday lunch, and one of the daily papers, in an account of the affair, said that, "The brokerage firm, of which he was the senior member, will be at once dissolved; the junior members refusing to continue in business with a man guilty of *such petty* dishonesty." He didn't steal enough.

The floating battery to be built by the Navy Department will be a steel ship, of the Monitor type, with double turrets, and will have a battery of two 12-inch and two 16-inch guns.

The London *Iron and Steel Trades Journal* says that the American manufacturer of machinery can, after paying 50 per cent. more in the way of wages, and 25 to 50 per cent. more for material, beat the English in price.

Notes on the Expansion of Steam.

BY RICHARD H. BUEL.

FOURTEENTH PAPER.

If the probable steam consumption of a non-condensing engine, using saturated steam, and with a steam-jacket, is to be calculated, the general formulas in Table *A* can be used, making *b*, the back-pressure, equal to 4½ pounds per square inch; and Table *D* contains the general formulas for the case in which the steam is superheated and the steam cylinder is not jacketed.

The results of the calculation, for all the assumed cases of cut-off, using steam cylinders having the same dimensions as were given in the general table, are here tabulated in an abbreviated form (Tables *K* and *L*), which can readily be extended by the reader who refers to the general formulas.

The economical results for steam-jacketed engines (line 57, Table *K*), as calculated theoretically, show a very small steam consumption for the points of short cut-off, and all the results, in fact, are rather better than are usually obtained in practice.

This is for the reason that steam jackets, as usually applied, do not act so efficiently as is assumed in this discussion. Table *M* shows results of some experiments with non-condensing engine, jacketed cylinder, and saturated steam, the effective horse-power being measured by a friction-brake; and the writer has found no reliable experiments which fully confirm the theoretical figures in line 57 of Table *K*. But it is evident that if a steam jacket can be operated so as to prevent all condensation of steam, other than that which takes place within the jacket itself, and if means are provided for draining the jacket of moisture so soon as condensation occurs, the practical results cannot vary greatly from those determined by theory. Few steam jackets act with this efficiency, and comparatively few engines are supplied with absolutely dry steam, for which reasons, the actual economy is usually less than the theoretical; but it is believed that the figures given in line 57, Table *K*, can be practically realized, by careful attention to details of construction and operation, in accordance with the principles stated in this discussion.

The records of complete experiments on the use of superheated steam in condensing engines are somewhat rare, but a few results are given in Table *N*, from comparative tests made on the merchant steamers "Georgiana" and "Adelaide," and the U. S. naval steamer "Eutaw." The steam consumption was not measured, except in the case of the "Eutaw," as given in Table *N* for points of cut-off .32, .50 and .58. In these experiments, the amount of superheat was not sufficient to prevent all condensation, and the engines were not designed, in all respects, so as to produce the most economical results; but, with all these drawbacks, the economy realized in practice shows that the theoretical figures are not very extravagant.

A summary of comparative experiments with saturated and superheated steam, made in 1859, is given in Table *O*, from data in Bourne's "Treatise on the Steam Engine." These figures are of especial value and interest, since they represent the results of long-continued trials; and it seems strange, in view of the great economy realized at that early date, that the use of superheated steam as a motive fluid for steam engines has received so little attention from designers and builders of steam machinery.

The discussion has now covered all the principal changes which can be made in the operation of simple engines, the theoretical calculations having been checked by practical data at every step. A brief summary of the theoretical results will appropriately close the discussion.

K.—Theoretical Results of Using Steam Expansively, Condensing Engines, Jacketed Cylinders, Dry Saturated Steam.

Item.		Symbol.	Formula.	Point of Cut-off. Full str'ke	3/4	1/2	1-3	1/4	1-6	1/8	1-12
Mean pressure, pounds per square inch.	Corrected for back pressure	M	59	90.5	87.7	77.6	64 8	55.7	43 8	36.1	28.3
	Cushion	k	65	——	5.2	6.3	7.5	8.4	9.7	10.8	12
	Corrected for back pressure, clearance and cushion	t	29	90.2	87.3	76.7	63.4	54	41.4	33.6	24.8
	Probable effective	e	30	85.7	82.9	72.9	60.2	51.3	39.3	31.9	23.6
Probable effective horse-power		(E)	39	177	177.3	178.7	184.6	195.1	219 1	245	300.3
Pounds of steam hourly.	By piston displacement	Q	47	5883	4924	3933	3415	3244	3264	3385	3838
	Condensed in jacket	(K)	76	5	141	263	856	426	554	675	950
	Total	(w)	77	5888	5065	4196	3771	3670	3818	4060	4788
	Per effective horse-power	(W)	57	33.3	28.6	23.5	20.4	18.8	17.4	16.5	15.9

L.—Theoretical Results of Using Steam Expansively, Condensing Engines, Superheated Steam, Unjacketed Cylinders.

Point of Cut-off.	Data from Table G. Pounds of steam hourly.	Data from Table G. Effective horse-power.	Pounds of steam hourly, per effective horse-power.
Full stroke.	5883	177	33.2
3/4	5582	178.9	31.2
1/2	4034	180.2	22.4
3/8	3611	188	19.3
1/4	3506	202.3	17.3
1-6	3619	228.6	15 9
1-8	4031	257 3	15 7
1-12	4480	321.9	13.9

M.—Experiments Made with a Condensing Engine, Jacketed Cylinder, Using Dry Saturated Steam.

Number of Experiment.	Diameter of Cylinder, Inches.	Stroke, Inches.	Per Cent. of Clearance.	Absolute Initial Pressure, Pounds per Square Inch.	Apparent Cut-off.	Piston Speed, Feet per Minute.	Effective Horse-power.	Pounds of Steam Hourly per Effective Horse-power.
1	22	43 5	3.7	118.8	.067	429	123.1	20.7
2				120.2	.125	421	178	21.3
3				75.9	.155	426	121	21.4
4				77.3	.25	428	163.9	22
5				48	.42	449	133.4	26.8
6				49.7	1	438	174.6	37.5

N.—Per Cent. of Gain by the Use of Superheated Steam in Condensing Engines with Unjacketed Cylinders—Theoretical and Practical Results.

Theoretical Results. Point of Cut-off.	Theoretical Results. Pounds of steam hourly per effective horse-power. Saturat'd Steam.	Superheated Steam.	Difference.	Per Cent. of Difference.	Practical Results. Point of Cut-off.	Practical Results. Pounds of steam or coal hourly per indicated horse-power. Saturat'd Steam.	Superheated Steam.	Difference.	Per Cent. of Difference.
Full stroke.	35.9	33.2	2.7	8.1	.65	3.71	2.99	.72	24.1
3/4	34 7	31.2	3 5	11 2	.60	3.07	2.74	.33	12.1
1/2	26.6	22 4	4.2	18.8	.58	31.4	26.1	5.3	20.3
3/8	24.5	19.3	4.6	23.8	.50	32 7	25.1	7.6	30.3
1/4	23.4	17.3	6 1	35.3	.45	3 38	2 91	.47	16.2
1-6	23.4	15 9	7 5	47 2	.35	2.73	2.33	.40	17 2
1-8	24 6	15.7	8.9	56 7	.32	30.6	28.4	2.2	7.8
1-12	24.8	13.9	10.9	78.4					

O.—Per Cent. of Gain by the Use of Superheated Steam in Marine Engines, 1859.

Vessel.	Total Coal—Pounds. Saturated Steam.	Superheated Steam.	Difference.	Per Cent. of Difference.
"Alhambra," Southampton to Lisbon and return	405,440	275,520	129,920	47.2
"Colombo," Southampton to Alexandria and return	2,900,800	2,287,280	613,520	26.8
"Norman," Southampton to Cape of Good Hope and return	1,554,560	1,189,440	365,120	30.7
"Ceylon," Southampton to Alexandria and return	3,364,480	2,291,520	1,072,960	46.8

Truing Up Cable Transmission Wheels.

BY A. B. LANDIS.

To ensure a steady and even movement of a power-transmitting cable, it is absolutely necessary to have true wheels, which are not always so, even when new, as they are merely filled with the rubber blocks, and not turned. In my experience, only a slight lack of truth in these wheels causes them to become more and more out of truth. At first there is a slight waving motion of the cable, and finally it gets so that the jerking becomes very severe and intolerable, shaking the building in which the wheels may be located.

After wrestling awhile with this difficulty, using various means without avail, to prevent the lashing of the cable, I found the difficulty to be in the wheels, which did not seem to

be much out of truth. As rubber is not the easiest thing to turn with chisels, I made a tool as shown enlarged in Fig. 2. I took a piece of 1-inch round steel, about six feet long, bent an end on it as at *E*, and cut it like a rasp. The other end I bent at right angles to this, so as to make a good hand hold to control the tool sideways. Now by making a support *A*, and slowing down the speed (with the throttle at the engine) as would be practicable, and holding the rasp steadily, so as to cut down the high points, the wheel can be speedily turned up, as the sharp rasp will cut down the rubber in an effectual manner and make a first class job. It has no tendency to tear the rubber blocks out of position. After this operation has been accomplished, we have a steady and even motion in the cable.

Whenever cable wheels are refilled, they should be trued up, and, as it is generally inconvenient to take them down, the tool described will be found very convenient and efficient.

Fig. 1

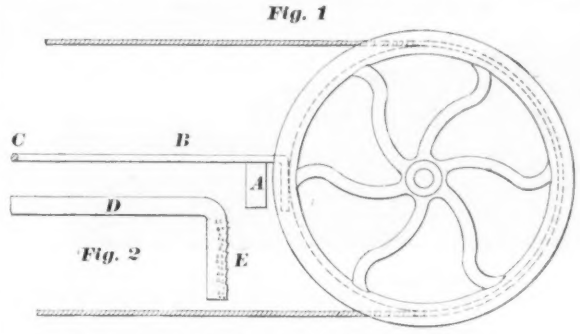


Fig. 2

Truing up Cable Transmission Wheels.

New England Water Works Association.

We are informed by Secretary Coggeshall that the next meeting of this association will be held at Young's Hotel, Boston, Mass., on Wednesday, Dec. 12th. The following is the programme:

11 *o'clock*. Meeting of the Executive Committee. Members are urged to meet promptly at the time designated.

12 *o'clock*. General business meeting. Consideration of all applications for membership, and any other business which may be presented.

1 *o'clock*. Lunch will be served promptly at this hour. Tickets, $1.50.

2 *o'clock*. Reading of Papers: "Construction and Management of Water Works," Hon. Chester W. Kingsley, Cambridge, Mass.; "What is the Safe Ratio of Pumping Capacity to Maximum Consumption?" W. B. Sherman, C. E., Providence, R. I.; "Water in some of its Higher Relations," Rev. D. N. Beach, Cambridge, Mass.

An Interesting Bridge.

BY PROF. JOSEPH TORREY.

I ran across a very interesting little piece of bridge architecture during my travels this summer. I was in the northern woods of Maine, and happened to hang out over night in the little village of Kingfield, at the terminus of the Franklin & Megantic R. R. (about 14 miles of track 2' gauge). In an after-supper stroll, my attention was arrested by the neat little chain suspension bridge, which crosses the Carrabasset river at that place. On closer acquaintance, the good design of the bridge, and its excellent adaptability to the place, with its spring freshets and ice, aroused my curiosity to know something of its history, and what I was told by some of the older inhabitants of the town interested me so much that I will give it to the readers of the AMERICAN MACHINIST. I will first give some idea of the dimensions of the bridge and its construction.

The span is 173 feet, the width about 12 feet in the clear. The chains are four in number, two on each side, carried over towers about 12 feet high. The towers are of wood, protected carefully by a shingled roof, and painted. They are apparently ample in strength, and very neatly designed. The chains are anchored at the ends, at a depth of 8 feet, under a heavy iron plate, through which the rod end of the chain is carried. The plates are held down by plenty of scrap iron and rocks. The floor system is supported in a very simple way, represented by the drawing. The hangers *h* are $\frac{3}{4}$" iron, and welded where the Y begins. The welding I examined with considerable care, and it seemed to be excellent. The chains are $\frac{7}{8}$" iron, made in England, and, together with the hangers, are kept carefully and thoroughly painted. There is no lateral bracing for the floor system, and no attempt at stiffening the structure vertically. It vibrates considerably under teams, but not enough to be inconvenient. As the bridge is built now, it yields somewhat to high water, and by this very yielding probably breaks the force somewhat. The entire floor system could be swept away without injuring the main body of the bridge at all, and a few hours' work would easily replace the floor.

The bridge has been standing in its present position for 36 years, which I consider a pretty good record under the circumstances. At the time it was built, the town had grown tired of losing one bridge per year, and summoned a few engineers from different places to look over the ground and make recommendations.

None offered any satisfactory solution but an engineer from Lewiston, Maine, who proposed a suspension bridge. His plans were considered carefully and accepted, and he was moreover engaged to come and superintend the erection. The chains were imported from England, being obtained at a pretty low figure, as my informant said; his memory could not recall the amount.

All work was done on the ground, and well and carefully done, too, as its record shows.

Several years after its completion it was exposed to a very severe test. During a very long stretch of unusually bad winter weather, the bridge became covered to a depth of nearly two feet with snow and ice. The chains were also twice their natural size with ice and snow. Under these circumstances, a heavy load of logs was being drawn across by a pair of oxen. The logs slipped from their place and fell onto the floor. The shock snapped a link in one of the south chains, which, of course, parted and fell. The remaining chain, however, held the floor up, thus doing twice its allotted work. The broken chain was taken down, the link replaced by a new one made by the local blacksmith, and the chain remounted without outside help. It was apparently a good job. At all events, the chain is still there.

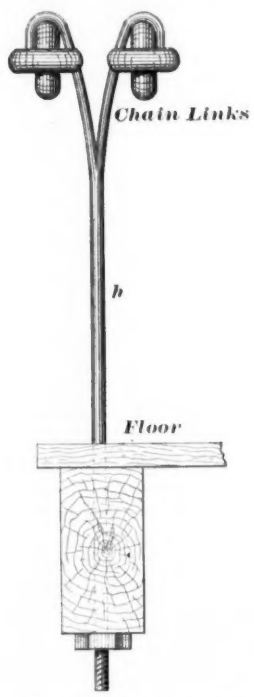
The bridge interested me most as being an instance of unusual sense manifested by a town in search of a bridge. I know of no place where so little judgment and ordinary common sense is ordinarily shown as in undertakings of this class. The moral is: When you have a bridge to build, decide as to what you want, call in a thoroughly able and reliable engineer (there are plenty of them), and let him make your plans and specifications. Have him examine all strain sheets and detail drawings, and make such inspections and tests of material as are needed. Have your contract in shape, and your engineer in charge of construction, and you will get a good bridge.

I only hope this little notice will meet the eye of the engineer who designed this little bridge, if, indeed, he is still alive. I should like to know him.

Bellite.

A new explosive, invented by Mr. Carl Lamm, a Swedish engineer and chemist, and which is being introduced into England, is called Bellite. It seems, according to the report of trials made with it—a full account of which is published in *Iron*—to possess some advantages peculiar to itself, the most prominent, perhaps, being its almost absolute safety from the danger of accidental explosion.

Cartridges composed of bellite were placed upon end on a piece of iron boiler plate, and



Floor Supporting System

AN INTERESTING BRIDGE.

an iron weight of 1,120 pounds let fall upon them from a height of 20 feet. There was no explosion, though the cartridges were crushed out of shape.

Pieces of the same cartridges were afterwards placed in tin cases and exploded by a capped fuse, tearing a hole through the boiler plate. Cartridges of bellite were placed in the midst of a pound of powder, which was ignited without exploding them. Some of them were placed upon a forge and melted without producing an explosion; the identical cartridges, or rather portions of them, being afterwards exploded by the proper appliances, to show that they were not inert.

Bellite placed in boxes composed of $\frac{1}{4}$" deal boards failed to explode when cartridges of the same were exploded upon the top of the box, breaking it up and scattering the contents about.

Further experiments showed that its action, while equal, if not slightly superior to dynamite in force, was slower, and distributed over a greater area. Finally it was shown that it gave out no flame in exploding, and left in the mine headings no noxious or injurious vapors, which prevent the miners from returning to their places immediately after the explosion. It is composed of dinitro-benzole and nitrate of ammonia in certain proportions, and then subjected to heat.

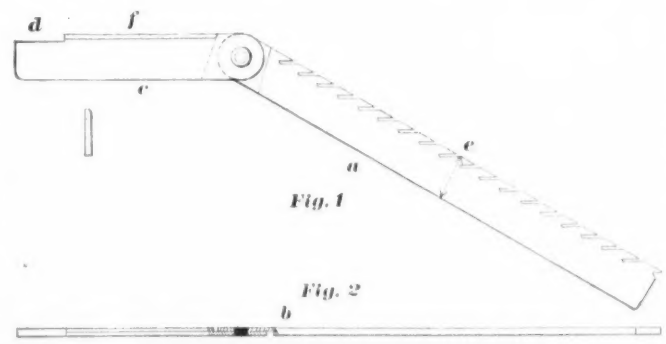


Fig. 1

Fig. 2

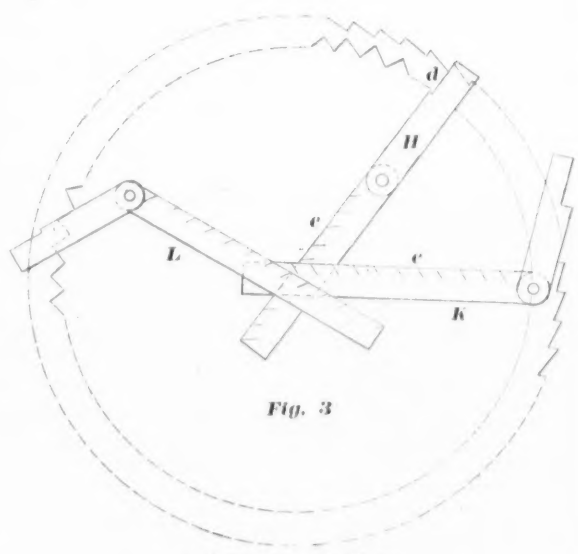


Fig. 3

A DRAFTSMAN'S KINK.

LETTERS FROM PRACTICAL MEN.

Looks Like Slow Cutting Speed.

Editor American Machinist:

In the line of your reply to F. W. P., Question 505, I have been running a wheel lathe for the last four years. I have obtained best results by running one revolution in three minutes, with a 56" center. The steel I use is a special steel made to turn steel tire. I turned $1\frac{1}{4}$" in diameter off of two pairs of wheels in less than 14 hours; that includes putting in and taking out of lathe.

HIGH PRIVATE.

A Draftsman's Kink.

Editor American Machinist:

Noticing some very useful "kinks" and rules for the draftsman in your excellent paper, I send you sketch of a "kink," which need only to be used to be appreciated on such work as mentioned below. Having occasionally to make drawings of ratchet wheels, with internal and external teeth, on scale drawings, with as many as 384 teeth on a 20-inch wheel, it was always with a feeling of dread that I commenced spacing the teeth for both points and roots of teeth, to say nothing of the numerous lines and punctures in the paper to spread the ink where the teeth are sharp. It was to avoid this tedious process that I had the instrument made, shown in Figs. 1 and 2. In the sketch *C* is a blade pivoted on *a*, with a portion cut away at *d* equal to the depth of the slots *e*, and beveled on the edge *f*. This instrument is used, as shown in Fig. 3. After spacing the *points* of the teeth, insert a needle in the drawing board at the center of the circle; slip the instruments over the needle at one of the slots, and if the face of the tooth is a radial line straighten out the instrument and use it as at *H*; and the blade *C* being cut away as at *d*, equal to the depth of the slot *e*, it will make a radial line. For the other angles use it as at *K* and *L*. If both sides of the tooth are the same angle, reverse the instrument. This is also a very convenient instrument for making angular lines which cannot be made by fixed triangles, such as screw threads, springs, etc. By enlarging, it will be found very useful for the pattern maker, and a very desirable addition to his "kit."

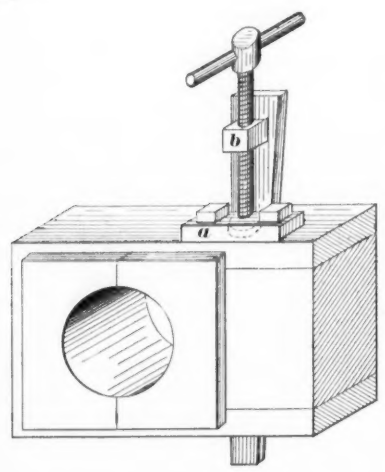
M. B. KURTZ.

Troublesome Crank-Pins.

Editor American Machinist:

The one bearing that the average engineer prides himself on—watches closer than any other, fits up neater, and worries more over—is the crank-pin. It is on his mind more than any other one thing, particularly if it gives much trouble. And sometimes they will cause you to hustle around and dig out the cause without much delay. There are engines that, through defective valve designing, or some other fault that builders never see in their own engine, cause trouble every day. The nice point on such an engine is in keeping the brasses just so they won't pound or run hot. The wear in such a case

is usually excessive ; I have seen cases where the engineer would touch the key every day. Probably the best way to drive a crank-pin key is to stop the engine, so that, in starting, the brass nearest the key will be loose. Then give enough steam to take up the lost motion, and with a lead pencil draw a line across the key, loosen the set screw, and a light touch will send the key home. Notice the philosophy of the use of the pencil, instead of the scratch awl. Again, with steam on, one can actually feel how loose or tight the brasses may be.



I saw a clever device that is worthy of place on some engines that are troublesome in this respect. The piece *A* is counterbored on one side and drilled for the two set screws. The stem has a collar to fit in counterbore of *A*. Get a set screw for *b* with a large head and drill and tap to fit the stem. Put a 3-inch hand-wheel or its equivalent on the top. The engineer had taken out the side set screw for the key, and, with his engine running 120 revolutions per minute, would raise and lower the key as circumstances required.

DUPLEX.

Protractor.

Editor American Machinist :

The accompanying drawing shows a convenient form of protractor for use by draftsmen. It is made of hard rubber, and, together with the 45° and 60° triangles ordinarily used, enables one to lay off any angle from 0° to 90° with considerable accuracy.

The drawing is one-half size, and shows it set at about 9° 35′.

As it is manipulated in the same manner as the triangles which are being used almost constantly, any draftsman can "catch on," and use it correctly the first time. In this respect it is superior to all others of similar construction.

Two fingers of one hand make the adjustment, leaving the other hand at liberty.

The inventor believes the fact of its being constantly borrowed in the office where it was made is sufficient ground for giving it general notice. It is not patented, and will not be.

HARVEY D. WILLIAMS.

Instructor in Mechanical Drawing in Sibley College.

Back for Blue Print Frame.

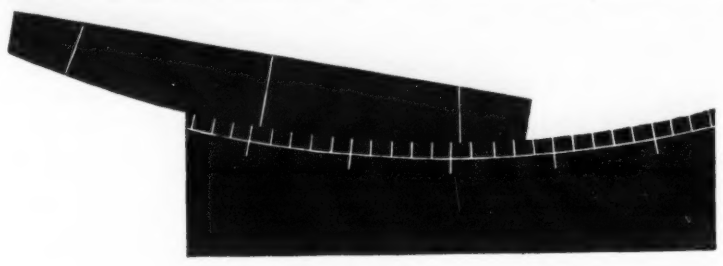
Editor American Machinist :

I enclose a sketch of a back for a blue print frame, which has proven very satisfactory in use. It is intended to overcome the difficulty which is often experienced in obtaining a perfect contact of the tracing to the glass. This it does by insuring a uniform pressure in all parts of the glass through the use of a system of equalizing levers. The sketch shows one-half of a back for a frame of 30 by 36 inches, the other half being a duplicate of this. It is necessary that the back be made in two parts, to permit examination of the print without disarranging it. This requirement is imperative in cloudy weather, and failure to meet it condemns some otherwise excellent arrangements. The general construction is manifest from the sketch, but it may be remarked that, in order to equalize the pressure at *a*, *b*, *c*, the levers *d e* are offset from the centers of *a b* and *b c*, as will be readily understood. The levers are fastened together by a common wood screw at each joint. These should not be screwed home, but should be left a little loose, to allow a certain degree of flexibility to the system, for obvious reasons.

If those of your readers who find it difficult to secure good contacts will try this device, they will find it to give as good results as any air bag or other expensive construction can give.

Can any of your readers tell me how to make good prints in hot weather ? Our prints are superior, except during the heat of summer, when they always look as though the paper had been partially exposed before putting the tracing over it. Others have the same trouble, and any information to the point would be of widespread usefulness.

FREDERIC A. HALSEY.



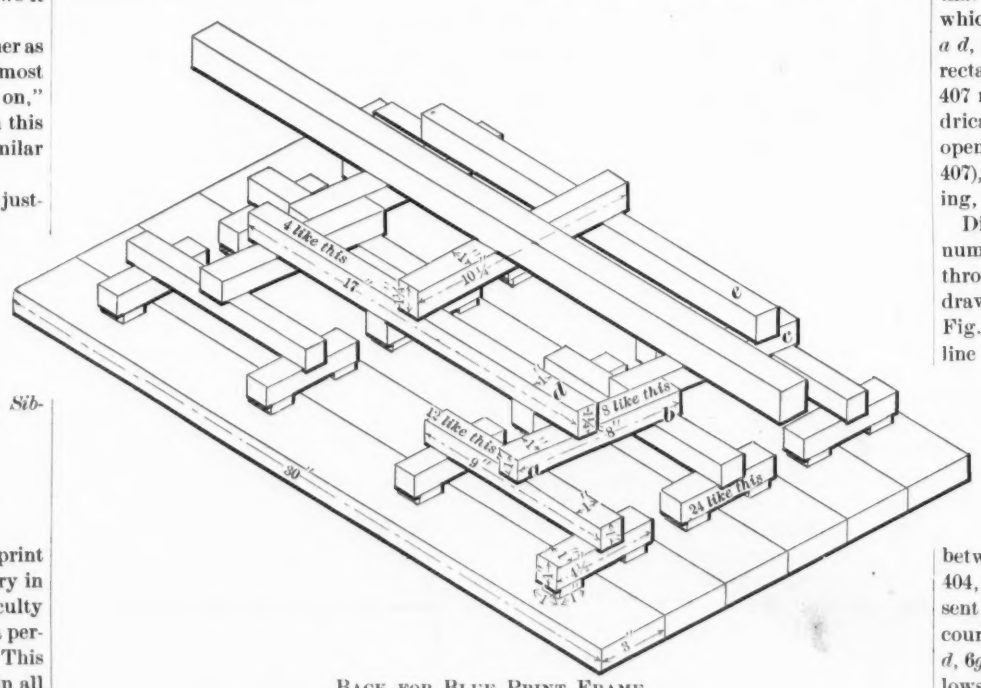
PROTRACTOR.

Attaching Paper Labels to Metallic Surfaces.

Considerable difficulty is experienced in attaching paper labels to metallic surfaces by means of gum or paste, and if the surface is bright the label pulls off with very slight provocation. The difficulty, however, is said to be easily overcome by washing the surface of the metal with a strong and hot solution of washing soda, afterwards rubbing perfectly dry with a clean rag. Onion juice is then applied to the surface of the metal, and the label pasted and fixed in the ordinary way. It is said to be almost impossible to separate paper and metal thus joined.—*Practical Engineer.*

An Inconsistency.

Our English contemporary, *Iron*, says in a recent issue, under the title, "Protectionist Blundering and Plundering":



BACK FOR BLUE PRINT FRAME.

Amongst the recent decisions respecting the classification of articles in the American customs tariff, and the interpretation and application of the customs laws of the United States, given by the American Government, the following case beats the record. The Canadian steam vessel "Geneva," which was imported into the United States from Canada, and received an American registry under the special provisions of the act of March 3, 1879, was subjected to the payment of duty. This, in the present state of the American customs laws, was natural enough. But what borders on the insane is that her machinery, although originally of domestic manufacture, was disallowed free entry as such domestic manufacture, on the plea that, "inasmuch as it had become merged into the vessel, it was not returned in the same condition as exported."

It is to be hoped that, after such an egregious demonstration of utter incapacity of grasping the first principles of political economy, we shall have no more complaints on the part of Americans as to the falling off of their export trade. Such a straining of the letter of the customs laws of the United States is protection gone mad.

We think few will deny that this is a just criticism, and shows how a stupid official interpretation may defeat the prime object of the law.

Practical Drawing.

BY J. G. A. MEYER.

SIXTY-FIFTH PAPER.

Problem 76.

514. *Development of cylindrical surfaces, continued.*

Let the circle *a b c d*, Fig. 404 (page 7), be the vertical, and the rectangle $a_2\ a_4\ c_2\ c_4$, Fig. 405, the horizontal projection of a cylinder through which is passed a smaller one whose vertical projection is represented in Fig. 404 by the rectangle $h\ h_3\ j\ j_3$, and its horizontal projection represented by the circle $h_2\ i_2\ j_2\ k_2$ in Fig. 405 ; the axes of the cylinders lie in one and the same plane, and this plane is represented by the center line $i\ b_2$. It is required to find the developments of the cylindrical surfaces, with the lines of intersections drawn on these developments.

Let us first find the development, such as is shown in Fig. 406, of the small cylindrical surface, and on this development construct the curves which separate the shaded part from the light parts. The shaded part in this development represents that part of the small cylindrical surface which is hidden in Fig. 404 ; and the light parts in Fig. 406 represent those which in Fig. 404 are exposed to view.

Fig. 406 represents only one-half of the development of the small cylindrical surface, and this half is represented in the horizontal projection of the cylinders (Fig. 405) by the semi-circumference $i_2\ j_2\ k_2$.

To find the development with the required curves drawn upon it, we proceed in the following manner :

In Fig. 405 draw the diameter $h_2\ j_2$ perpendicular to the center line $i\ b_2$. Divide the arc $k_2\ j_2$ into any number of equal parts, say four ; through the points of division 2, 3, 4 draw vertical lines, cutting the circumference *a b c d* (Fig. 404) in the points 2*e* 3*e* and 4*e* respectively ; it should also be noticed that in Fig. 404 the element $j\ j_3$, and the center line $i\ i_3$ cut the circumference *a b c d* in the points 5*e* and *b*. Prolong the line *h j* to any convenient distance towards k_5, and make $i_5\ k_5$ equal to $\frac{\text{diam. } h\,j \times 3.1416.}{2}$

Divide the line $i_5\ k_5$ into twice as many equal parts as have been spaced off in the arc $j_2\ k_2$; we say twice as many, because the line $i_5\ k_5$ represents one-half of the circumference of the small cylinder, whereas the arc $j_2\ k_2$ represents only one-quarter of the same circumference. Through the points i_5, k_5, and also through the points of division 2*m*, 3*m*, etc., draw vertical lines, terminating in the line $i_7\ k_7$, which is parallel to $i_5\ k_5$; the distance between the lines $i_5\ k_5$ and $i_7\ k_7$ must, of course, be equal to the length of the small cylinder. Through the points *b*, 2*e*, 3*e*, 4*e*, 5*e*, in Fig. 404, draw horizontal lines ; the first cutting the vertical line through i_5 (Fig. 406) in the point *l* ; the second cutting the vertical line through 2*m* in the point 2*l* ; and so on in succession, thereby obtaining the points *l*, 2*l*, 3*l*, 4*l* and 5*l*.

Since the axes of the cylinders lie in one plane, the curve *l* 5*l n* will be symmetrical about the line drawn through 5*m*, and therefore the line $k_5\ n$ will be equal to the line $i_5\ l$; 2*p* 2*n* equal to 2*m* 2*l*, and so on ; in this manner we obtain the points *n*, 2*n*, 3*n*, and 4*n*. The line drawn through the points *l*, 2*l*, . . . 2*n*, *n* will be the required curve, and the rectangle $i_5\ i_7\ k_5\ k_7$, will be one-half of the development of the small cylindrical surface.

The curve $o_2\ r_2\ s_2$ is equal to the curve *l* 5*l n*, and is found in a similar manner as that adopted for finding the latter.

We have already seen that the development shown in Fig. 406 is only one-half of the whole development. The other half is an exact duplicate of the one just found.

The principles upon which this construction is based are the same as those given in connection with Problem 74 ; the principles given in connection with Problem 59 are also applicable ; examine both and compare the constructions of those problems with the construction of the present one.

515. *To find the development of the openings made in the large cylindrical surface by passing the small cylinder through it.*

Fig. 407 represents the development of that portion of the large cylindrical surface, which, in Fig. 404, is represented by the arc *a d*, and in Fig. 405 is represented by the rectangle $a_2\ a_4,\ b_2\ b_4$. Consequently, Fig. 407 represents one-quarter of the large cylindrical surface with one-half of one of the openings. To find the curve 5*k*, h_9 5*i* (Fig. 407), which is the boundary line of the opening, we proceed as follows :

Divide the arc *d* 9*g*, Fig. 404, into any number of equal parts, say four ; and through the points of division 6*g*, 7*g*, 8*g*, draw vertical lines, cutting the radius $x_2\ h_2$, Fig. 405 (drawn perpendicular to the center line $i\ b_2$) in the points h_6, h_7, h_8, and also cutting the arc $h_2\ i_2$ in the points 6, 7, 8. Prolong the radius $h_2\ x_2$ towards s_2, to any convenient distance from Fig. 405. From s_2 on the line $h_2\ s_2$ lay off in succession four points, s_6, s_7, s_8 and d_9 ; the distance between these points must be equal to distances between the points *d*, 6*g*, 7*g*, 8*g*, 9*g*, in Fig. 404, so that the line $s_2\ h_9$ in Fig. 407 will represent the development of the arc *d* 9*g*. Of course, since the distances between the points *d*, 6*g*, 7*g*, etc., are equal to each other, it follows that the distances between the points s_2, s_6, s_7, etc., in Fig. 407, will also be at equal distances from each other. It will be well to remark that, in many practical problems, the length of the line $s_2\ h_9$, which we have seen represents the developed length of the arc *d* 9*g* shown in Fig. 404, is obtained in a manner as just explained. Now, in order to obtain the correct length of the line $s_2\ h_9$, it is always advisable to divide the arc *d* 9*g* into a greater number of equal parts than four ; the reason for this will be apparent by referring to Problem 58 A. Through the points of division s_2, s_6, s_7, and s_8 draw lines perpendicular to $s_2\ h_9$. Through the point i_2 (Fig. 405) draw a horizontal line (which, of course, will and must, in all cases, be parallel to the

center line $h_2\ s_2$) cutting the line $b_5\ b_7$ in the point $5i$; through the point 6 draw a horizontal line, cutting the line $6t\ 6k$ in the point $6t$; draw also horizontal lines through the points 7 and 8, cutting the lines $7t\ 7k$ and $8t\ 8k$ in the points $7t$ and $8t$ respectively. Make $s_2\ 5k$ equal to $s_2\ 5i$; $s_6\ 6k$ equal to $s_6\ 6t$ and so on. Through the points $5i$, $6t$, $7t$, $8t$, h_9, $8k$, $7k$, $6k$, and $5k$ draw a curve which will be the required boundary line of one-half of one of the openings.

The rectangle $a_5\ a_7\ b_5\ b_7$ is the development of one-quarter of the cylindrical surface, and is found in the same way as the development of any other cylindrical surface is found, as explained in previous problems. The developments of the other quarters of the same cylindrical surface are exact duplicates of that shown in Fig. 407, and when these are correctly laid side by side, so as to show the total development of the cylinder, they will have an appearance similar to Fig. 319, although this figure represents a development of a different kind of surface.

These problems are of great practical value, as similar ones frequently present themselves in laying out work; particularly in laying out plates for boilers. For instance, let the circle $a\ b\ c\ d$ in Fig. 404 represent the end of a boiler, and $h\ j\ h_5\ b\ 5e$ the dome; suppose, now, that it is required to lay out a plate for the dome. Here, then, we have a practical example, to which the solution of the last problem is applicable, as will be explained later. Leaving the thickness of the plate and the lap out of consideration, the surface bounded by the lines $i_5\ k_5$, $i_5\ l$, $k_5\ n$, and the curve $l\ 5l\ n$, in Fig. 406, will be one-half the development of the dome.

Again, suppose that the circle $a\ b\ c\ d$ in Fig. 404 represents a wrought-iron shell, and the lines $h_5\ 9g$, $5e\ 5f$ represent a wrought-iron circular pipe riveted to the inside of the shell so as to give a clear opening through it. Now let it be required to lay out the plate for the circular pipe $h_5\ 9g\ 5e\ 5f$. Leaving the thickness of the plate and lap out of consideration, one-half this plate, before it is rolled, will appear as represented by the shaded part in Fig. 406.

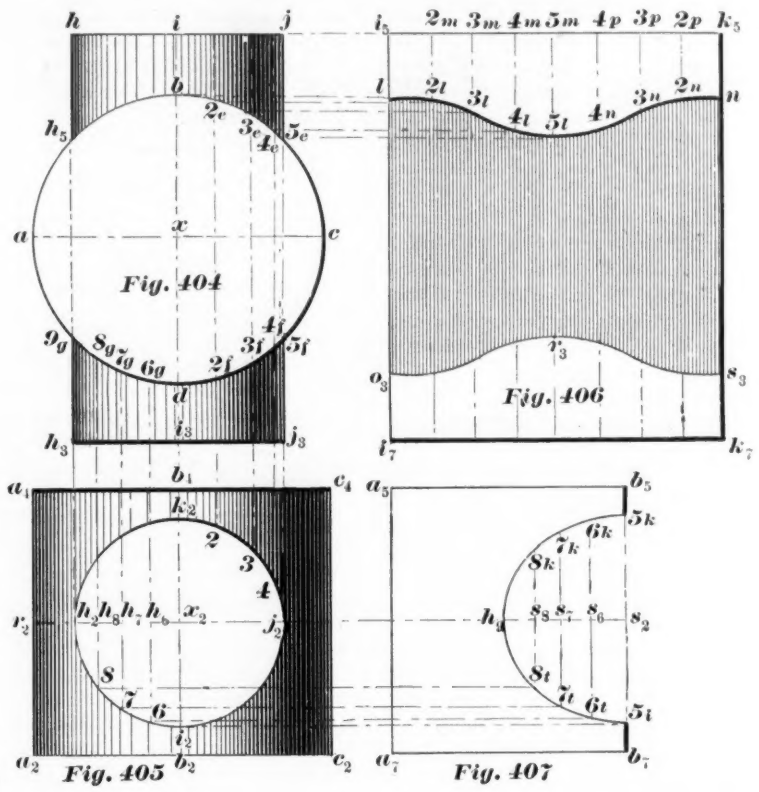
Directions. In the space marked Problem 76 draw two cylinders. The larger one is to be 8 inches diameter and 7½ inches long; the smaller cylinder passed through the larger one, is to be 6 inches diameter and 12½ inches long; the axes of both cylinders are to lie in one plane, as represented in our illustrations. Find the developments as shown in Figs. 406 and 407. Use 3 inch scale.

Problem 76 A.

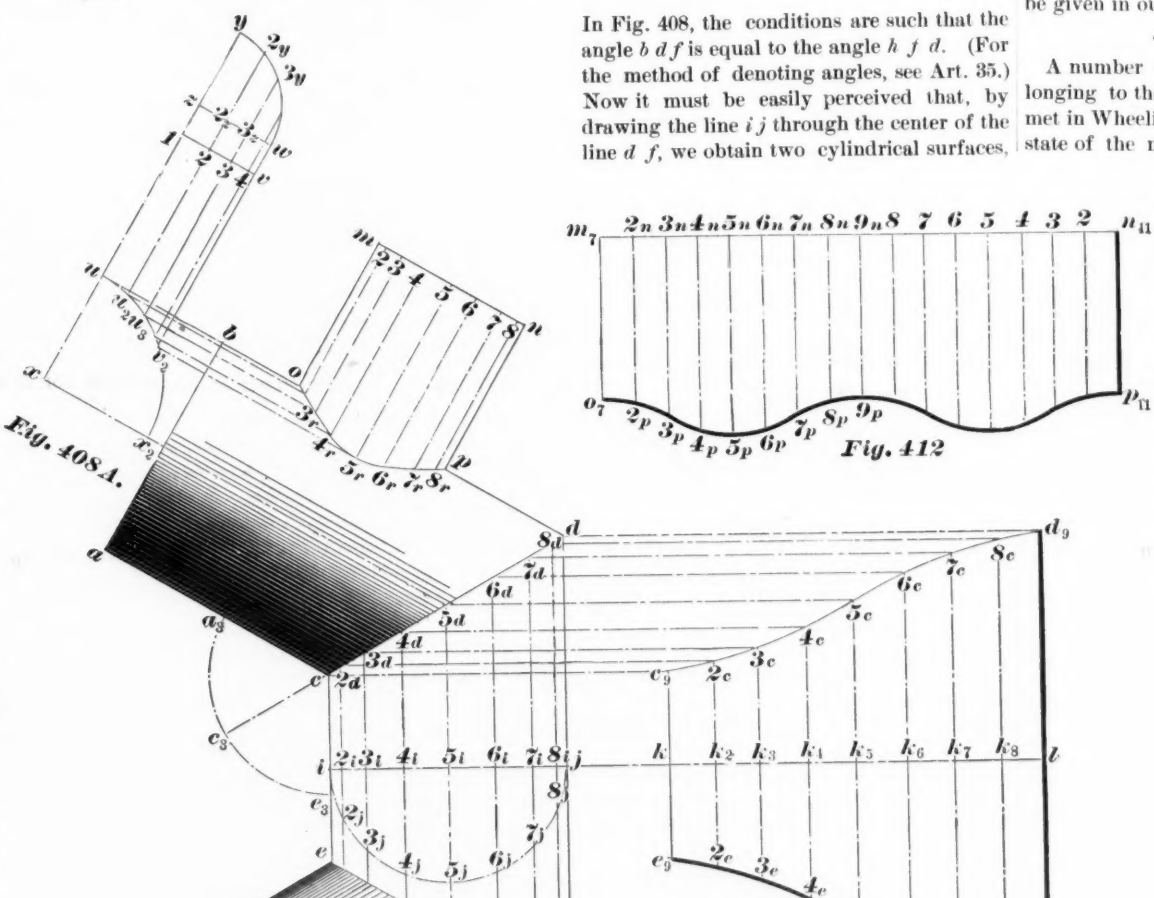
516. In this problem we have four cylinders, as shown in Fig. 408. All the cylinders have circular bases, and their axes lie in one plane, which is parallel to the vertical plane of projection. It is required to find the development of their surfaces.

This problem is given for the purpose of making application of the solutions of former problems, and also for the purpose of giving a few practical hints by which labor may be saved.

To find the development of the cylindrical surface $c\ d\ e\ f$ (Fig. 408), we apply the construction shown in Figs. 378, 380, given in connection with Problem 74. Here the question may be asked: How can this construction be applied, when in Fig. 378 we have a base at right angles to the axis of the cylinder, from which the points in the required curve are laid off, and in Fig. 408 we have no such base? True, but it is an easy matter to establish in Fig. 408 such a base, by drawing the straight line $i\ j$ perpendicular to the axis of the cylinder. This line $i\ j$ will divide the cylindrical surface into two parts, each of which will be similar to bb_3, cc_3 in Fig. 378; and can find their developments by the method given in Problem 74.



In Fig. 408, the conditions are such that the angle $b\ d\ f$ is equal to the angle $h\ f\ d$. (For the method of denoting angles, see Art. 35.) Now it must be easily perceived that, by drawing the line $i\ j$ through the center of the line $d\ f$, we obtain two cylindrical surfaces, $c\ d\ i\ j$ and $e\ f\ i\ j$, which are exactly alike. Therefore, in order to save labor in finding the development (shown in Fig. 409) of the cylindrical surface $c\ d\ e\ f$, we proceed in the following manner, which we shall describe very briefly.



Through the point j, which bisects the line $d\ f$, draw the diameter $i\ j$ perpendicular to $d\ f$. On this diameter describe the semi-circle $i\ 5j\ j$, and divide the semi-circumference $i\ 5j\ j$ into any number of equal parts, say eight. Through the points of division $2j$, $3j$, etc., draw lines parallel to $d\ f$, terminating in the lines $c\ d$ and $e\ f$, and cutting the diameter $i\ j$ in the points $2i$, $3i$, etc.

Now see Fig. 409. Make the line $k\ l$ equal to the $\frac{\text{diam. } i\ j. \times 3.1416}{2}$, and divide the line $k\ l$ into the same number of equal parts as have been spaced off in the semi-circumference $i\ 5j\ j$. Through the points k and l, and also through the points of division $k_2\ k_3\ k_4$, etc., draw lines perpendicular to the line $k_2 l$. From the point k as a center, and with a radius equal to $c\ i$ (Fig. 408), describe two short arcs cutting the perpendicular $c_9\ e_9$ in the points c_9 and e_9; from the point k_2 as a center, and with a radius equal to $2i\ 2d$, describe two short arcs cutting the perpendicular $2c\ 2e$ in the points $2c$ and $2e$; in a similar manner find the points $3c$, $4c$, $3e$, $4e$, etc., and draw the curves through the points so found. The curves $c_9\ 5c\ d_9$, $e_9\ 5e\ f_9$ and the lines $c_9\ e_9$, $d_9\ f_9$ will form the boundary of the development of one-half of the cylindrical surface $c\ d\ e\ f$; the other half is an exact duplicate of the one just found.

Remarks relating to the other figures will be given in our next paper.

A number of the nail manufacturers belonging to the Western Cut Nail Association met in Wheeling on Tuesday, to consider the state of the nail trade, and to take measures to counteract the demoralization of prices. A dispatch says the result will probably be an association of the leading mills in the West, with a view of establishing a uniform rate for the product, and to put a check to the cut-throat business now practiced. A harmonious agreement was reached at the meeting. It provides for a guarantee fund as a pledge of good faith from each mill, and will go into operation at a very early day.—*American Manufacturer.*

A correspondent of the *New South Wales Railway and Tramway Review* says:

Referring to the sleeping-car, a brief history of its invention will be found in Andrew Carnegie's "Triumphant Democracy." The inventor, who is described as a tall, spare, farmer-looking kind of man, was T. T. Woodruff. The first two cars used were run on the Pennsylvania Railroad. Seeing that the cars would be a paying venture, Geo. M. Pullman laid plans which resulted in his gaining the entire monopoly of making them. At the present time this company has a paid-up capital of about £6,000,000, and its ramifications extend everywhere.

Several of our contemporaries are worrying over the fact that structural weakness has been shown in the British gunboat "Scout," after which it is supposed some of our own gunboats in process of construction have been modeled. We have reason to believe that this has been provided for, and that the mistakes in the construction of the "Scout" will not be copied on this side.

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NEW YORK, DECEMBER 15, 1888.

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Manufactures and Municipal Taxation.

The complaint comes from Paterson, that the burden of taxation has become so high that it is impossible for some of the manufacturers to bear it, the result being that many of the silk mills have, as their business increased and greater capacity was needed, built what are called annexes in the smaller towns of New Jersey and Pennsylvania, where taxes are very low, and cheap labor is to be obtained.

Thus Paterson is deprived of the benefit which ought to accrue to her as a result of the natural growth of her leading industry.

It is stated that the population of the town has doubled within a few years, the growth being caused chiefly by the development of the silk industry, which is now so seriously crippled by municipal taxation. This appears to us to be a plain case of killing the goose that lays the golden egg, and calls to mind some of the absurdities of the usual system of levying and assessing taxes in manufacturing towns. Most towns consider the development of manufacturing enterprises within their borders desirable, but in too many of them the plan pursued with respect to taxation would seem to be especially designed to discourage the growth of manufactures, and, on the other hand, to encourage that which has a direct effect in hindering the growth and development of a town.

The establishment of manufacturing enterprises in a small town is often determined partly by the low rate of taxation. No sooner are the factories fairly under way than the little town commences to be a big town. The outlying farms are bought up by speculators and staked off into building lots and streets. The selling value of this land is thus multiplied to two, three, and often ten times the value it had before the manufacturers came, and the streets opened up through it, the extension of the water-works, gas, sewerage, etc., involve a heavy expense, which must be met by taxation. The rate of taxation need not be increased to meet this extra expense, if a rational system of assessing values were followed. But, instead of this, the speculators are generally able to get their vacant lots assessed for taxation at a mere nominal figure, upon the plea that they are unproductive, and therefore should not be heavily taxed. Thus the total assessed valuation of taxable property is kept down and prevented from keeping pace with the cost of new improvements, and the extension of the municipal departments, which of course necessitates an increase of the tax rate, and the manufacturers, being unable to escape on the plea of unproductiveness of their property, have to pay the full penalty of their enterprise. Thus it is seen that they not only cause, by their employment of labor, the growth of the town, and the consequent rise in value of the land-speculators' property, but are made to pay the cost of improvements, new streets and enlargement of the municipal departments generally, which in no way benefit them at all as manufacturers, but are solely for the benefit of the speculators, who reap their harvest in the rise of value of their property, though they contribute nothing to the growth of the town in any way, employ no labor, and produce nothing whatever. The low valuation assessed upon idle real estate held for speculative purposes, upon the plea that it is unproductive, is a humbug. Such real estate often is more productive (of money which goes into the pockets of the speculator) than is the property of the manufacturer with his capital and labor added.

The manufacturer's old man of the sea is the land-speculator, who follows everywhere he goes, clings about his neck, and often chokes the life out of him.

If there is any justice in making a manufacturer pay, in taxes upon the land occupied by him, ten times as much as is paid upon vacant land across the street from him, which is, exclusive of improvements, of exactly equal value, but is held idle by a speculator in anticipation of a further rise in value, we would like to have it pointed out.

It often happens, that while the manufacturer, by his operations, causes the growth of the town, and the consequent increase of values, the speculator, who does nothing towards this, makes the most money, and it would seem as though he should pay more taxes for keeping lots idle and hindering the growth of the town, than the manufacturer pays for using his lots and helping the growth of the town. Is not this a common-sense view of the matter?

A Magnificent Gift.

I. V. Williamson, a wealthy gentleman of Philadelphia, has given $5,000,000, with the prospects of more to come, if needed, to found a mechanical school where boys can be taught trades.

Mr. Williamson, being eighty years of age, has wisely put the matter into the hands of prominent citizens of Philadelphia, who will attend to all the details, over which he has been busy for two years. The gift is magnificent in its proportions, and we trust that, like Peter Cooper, the donor may to live see his plans successfully carried out.

Electric Motor on the L Road.

A trial trip with Daft's electric motor was made November 26th, on the Ninth avenue L road. It was attached to three cars, carrying about 120 guests and a few officers of the company. The run was made from 14th to 50th street and return; time from 14th to 50th street about nine minutes. The motor seemed to work successfully, and another trial is soon to take place. Whether the electric motors will do the work required of them in the regular service is still a problem, which can only be solved by trials and experiments.

The idea of successfully—as compared with other means of propulsion—propelling a boat by means of discharging a jet of water astern from a pump, comes up serenely every few years as something new. Just at the present time, according to the daily press, a New York gentleman has "invented" this plan of propulsion, and the "invention" has been capitalized at several million dollars. The idea of propelling a boat in this way suggested itself in the early days of the steamboat, to an observing mechanician, from discovering that a small water bug got ahead by similar means. And the scheme has been tried a number of times during the past fifteen years, but it has always been found costly and unsatisfactory.

Another recent invention in steamboat propulsion, that has more of novelty, but, probably less of utility, consists in exploding gas in tubes, the reaction against the water, of course, moving the vessel. There is, we think, nothing in either of these schemes that renders the abandonment of the screw and paddle-wheel imminent.

We desire to obtain a clean copy of No. 2, Volume II, of the AMERICAN MACHINIST, in condition for binding, and will pay one dollar for it. Sender should put his name on the wrapper, and write us a line, advising us that it has been sent.

Literary Notes.

PREPARING FOR INDICATION. Practical Hints, the result of twenty-three years' experience with the Steam Engine Indicator. By Robert Grimshaw, M. E.

This is a small book of 56 pages, and contains numerous illustrations of indicator rigs, manner of attaching the indicator to the cylinder, etc. No doubt engineers who use the indicator will find the book valuable. It is published by the Practical Publishing Co., 21 Park Row, New York. Price $1.00.

TWENTY YEARS WITH THE INDICATOR. Being a practical Text Book for the Engineer or Student, with no complex formulas. With many illustrations and rules as to the best way to run any Steam Engine to get the most economical results. How to adjust valves and valve motions correctly. Full directions for working out horse-power, the amount of steam or water per horse-power, economy of fuel. The author's original and correct application of the theoretical curve, to show exactly where the steam valve closed, and whether valves leaked or not; extended directions for attaching the indicator, what motions to use and those not to use. Full directions for computation of power by planimeter and other methods, with many tables and hints. Newly arranged and complete in one volume. Seventh Thousand. By Thomas Pray, jr., Consulting and Constructing and Civil and Mechanical Engineer, member of various societies, etc. New York: John Wiley & Sons, 15 Astor place. Price $2.50.

The subject matter of this book was written by the author for the Boston *Journal of Commerce*, while he was editor of that journal. On its first appearance in book form, it was issued in two volumes; these are now consolidated into one volume, making a large book of 284 pages. The articles are in the form of lessons, and the diagrams, of which there is a large number used for illustration, are from actual practice. As issued in two volumes, the work has met with a ready sale; in a single volume it will be found more convenient for reference. The price of the book is $2.50.

We have received from the American Iron and Steel Association a 24-page pamphlet which is a collection of statistics to the close of 1887, relating to the iron and steel industries of the United States, together with statistics enabling a comparison to be made between this and other countries, especially Great Britain, with respect to the growth and volume of those industries, and the prices of their products. The pamphlet contains a great deal of valuable information regarding these matters, which will be of great assistance to those who are interested in, or who wish to make a study of these matters. One of the tables shows that the United States are the leading producers of rolled iron, and second only to Great Britain in the production of steel. It is shown that we produce 29 per cent. of the world's annual output of pig iron, and 35 per cent. of its annual output of steel. Another table shows the prices of pig-iron, bar-iron, and iron and steel rails in the United States for each year from 1846 to 1860, and from 1874 to 1887.

The figures given for the latter period, when computed, show a decline in price of pig-iron of 30.57 per cent. Bar-iron declined during the same period 27.34 per cent., and steel rails 60.61 per cent. The table giving the prices of the same products during the same period (1874 to 1887) in Great Britain, shows a decline in price of pig-iron of 56.36 per cent., bar-iron 59 per cent. (this is an average of the two varieties quoted), and steel rails 71.74 per cent.

Accompanying this pamphlet is another, which brings the information down to the end of the first half of the year 1888, giving an account of the growth of the iron industry in the South, and an account of the use of natural gas in the manufacture of iron and steel in the United States. The price of the first named pamphlet is $1.00, the price of the other not being given.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(530) H. W., Catlettsburg, Ky., writes: Please give me instructions in the method of making blue prints. *A.*—See answer to Question 449, AMERICAN MACHINIST, Nov. 5, 1887.

(531) J. F. J., Johnstown, Pa., writes: To settle a dispute, please state how many pounds of steam will be equal to one pound of compressed air? *A.*—We do not understand your question. State the points in dispute and we will answer.

(532) Reader, ———, writes: I have a great desire of becoming a sea-going engineer; am a good machinist and have a good practical knowledge of steam engines. I am not situated in a locality where I can watch for a chance. How shall I proceed to obtain a position? *A.*—We should advise you to obtain employment in a first-class establishment in which marine engines are built, and establish a reputation as a first-class machinist

and as a man of intelligence, trustworthiness and sobriety. Then make known your wishes, and we believe you will have no difficulty in obtaining the desired position.

(533) C. A. R., Williamstown, W. Va., sends us a sketch of a diagonal boiler brace, and asks: Please give me a rule for finding the stress to which this brace can be subjected. *A.*—See answer to Question 314, in our issue of July 23, 1887, and also answer to Question 505, Dec. 10, 1887.

(534) R. O., ——, Conn., asks: Can gas be compressed? If so, how small a space can 1,000 cubic feet be forced into? *A.*—Gas can be compressed. The space to which it can be compressed in practice will depend on the strength of the vessel into which it is to be compressed, and the available power to do so.

(535) G. A. N., Aberdeen, D. T., asks: Is a locomotive a direct or indirect acting engine? If direct, what makes it so? *A.* We understand a direct acting engine to be one in which the projected motion of any point in the crank-pin, the plane of projection being perpendicular to the axis of the pin, has the same direction as that of the motion of any point in the piston. According to this definition, the locomotive is a direct acting engine.

(536) W. L. S., Washingtonville, O., asks: 1. How much lap should be given to a slide valve for an engine whose steam ports are 1 inch × ¼ inch? *A.*—The lap will depend on the point of cut-off, which you do not give. 2. Should the throw of the eccentric be equal to the sum of the width of the steam port and the lap? *A.*—The eccentricity of the eccentric should be equal to the sum of the width of the steam port and the lap; sometimes it is made a little greater. The throw is equal to twice the eccentricity.

(537) H. B., Harrison, Me., writes: I would like to hear from some of the readers of the AMERICAN MACHINIST, their method of finishing quick-running steel journals like buzz planer, saw arbors, etc.; what kind of files they use, etc. *A.*—Perhaps some of our readers can give this correspondent some points in regard to this matter, and, though our opinion is not asked in the matter, it is proper to say that files should not be used on such journals at all, but they should be finished by grinding or lead lapping after turning.

(538) S. H., New York, writes: Can you tell us a good cement, or what will make a permanent joint between two cast-iron plates? It must resist steam and water, say up to 150 pounds' pressure. *A.*—Some engineers use for faced joints common drawing paper soaked in oil. After a short time the heat of steam converts it into a substance like parchment, so that it is practically indestructible. If the cast-iron plates are not faced, but are moderately true, a rubber joint may answer your purpose. If the plates are very rough, you may be compelled to drive a rust joint.

(539) C. A., Bucyrus, Ohio, asks: Which is the cheapest method for silver and nickel plating? And which is the best book which treats on this subject? *A.*—The method varies with the different kinds of material to be plated. Some of these methods are also patented. It seems to us that the only way to obtain the information which you seek, is to engage in an establishment in which such work is done; or, if you intend to start a business in this line, engage a competent person to assist you. We do not know of any books treating on this subject, and therefore cannot recommend any.

(540) B. T., Marietta, Ohio, asks: Please tell us what qualifications an applicant for second engineer's license must possess to obtain such from the supervising inspectors of steam vessels? *A.*—See answer to Question 320, in our issue of July 7, 1888. 2. Is there any benefit derived from running a stream of cold water on a piston-rod to keep hemp packing from burning out as soon as the steam pressure is 170 pounds? *A.*—No; it is bad practice. Under the care of good engineers, who will take care that the stuffing box gland is not screwed up too tight, and will keep the cylinder lubricated, such trouble will not occur.

(541) E. C. G., Brooklyn, N. Y., writes: Will you please inform me why, in answer to Question 510, you gradually increase the power-transmitting capability of leather belting from 1 horse power for each 750 feet per minute traveled by a one-inch belt, to over 2 horse-power per inch in width of a 12-inch belt, traveling at the same speed? *A.*—Because a 12-inch belt is made thicker than a belt one inch wide. It must also be understood that, determining by the width of the belt, the power required to drive a machine gives only approximate results, as we have stated; and the belt should not be considered, so to speak, to be a dynamometer.

(542) F. H., Fall River, Mass., sends us two sketches of a universal joint. In both sketches one shaft is horizontal, the other making an angle of 45 degrees with the former. The difference between the two sketches is that in one sketch the pin through the horizontal yoke is placed in a direction towards the horizontal shaft, away from the pin in the oblique yoke. In the other sketch, the pin through the horizontal yoke is placed in a direction towards the oblique yoke, the distance between the pins being the same as before. The question is then asked: Which is the best of the two methods to couple them? *A.*—There is no choice between the two methods; neither is good practice. The axes of the pins, or rather pivots, should lie in the same plane.

(543) E. F., ——, Ind., writes: I have a number of cast-iron plates 8 feet x 12 inches x ½ inch thick. I would like to cut these plates into different lengths. I have been drilling a row of holes across them at the desired length, and split the end off; but this is too slow a process. Would you please let me know if I could cut them off with a saw, the kind of saw, and its speed? *A.*—We believe you can cut the plates with a circular saw. The speed of the saw will depend on the quality of the casting; probably a speed of 300 feet per minute may answer your purpose. 2. A cast-iron column, which has sprung in the sand, and whose transverse section is similar to that of a channel iron beam, depth of face, 8 inches, width of flanges 27 inches, length 20 feet; can it be straightened? *A.*—We believe not; the cheapest and best way will be to re-cast it.

(544) A. B., Woonsocket, R. I., writes: 1. Will you please inform me if the use of soda ash in boilers would be apt to eat away the scale? Would it cause the tubes to leak, which are a little poor? *A.*—Soda ash is sometimes used with good effect, for the prevention of scale, and when the formation of scale has ceased, the old scale is liable to drop off gradually. The best way would be to have the scale analyzed, and then use such compound for the prevention of scale as may be determined by the analysis. We do not believe that its use will injure the flues; yet, if they are poor, as you state, we would strongly advise you to take the flues out and replace them by perfect ones, whether you use a compound or not. 2. About how much per week should be used for 75 horse-power boiler? *A.*—You may commence with about two pounds per week; this quantity may be increased a little, should circumstances require it. 3. Will its use eat the oil in the cylinders? *A.*—No.

(545) C. B., South Boston, Mass., writes: We wish to cast iron around a steel or iron shaft, the length of the casting being 4 feet 6 inches, and the thickness of metal is from 1 inch to 2½ inches; the shaft is 2 inches diameter, and extends beyond the casting 3 inches at each end. Will pouring the iron weaken the shaft, or change its length, or spring it? *A.*—It will not weaken the shaft, except as it may, by annealing it, reduce its stiffness slightly, neither will it materially change its length. It will spring the shaft to some extent, but, as you will make an allowance for turning the journals after the casting is cold, we do not see as this will be a serious matter. Casting rolls, etc., on wrought-iron centers, and afterwards turning the ends, is very frequently done. We have never heard of the use of steel centers. Some precautions are necessary to make a good job. You will find the matter quite fully discussed by correspondents of the AMERICAN MACHINIST, in the issues of May 9, 23 and 30; June 6, 20 and 27, and Aug. 1, 1885.

(546) W. H. E., Reading, Pa., writes: I have been a subscriber of the AMERICAN MACHINIST for eight years, and have never seen an illustration of a working model of the valve motion. I am a machinist, and would like to know more about valve motion, and I think that a working model would be just the thing. I want to make one, which can be adjusted to suit a wide range of engines, but I want to see one first, such as they use in drawing-rooms. *A.*—You will find an illustration of a link and valve motion model on page 1, May 26, 1883. No doubt but that a model will greatly help you to understand the link motion, and will be of great usefulness. But after you have once mastered the subject, and also understand mechanical drawing, you will not need a model for laying out a valve motion. Good draftsmen work it all out on paper, and, after the details of the valve motion have been determined, may sometimes have a model made, simply for the purpose of checking the correctness of their design. Very few drawing offices have such a model as you desire to make.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

The Best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W. Washington, D.C. Send for pamphlet and references

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Mechanical drawing taught by correspondence. Thoroughly practical. I. Donald Boyer, Dayton, O.

The Waterhouse Electric and Manufacturing Co., Hartford, Conn., have a steady arc light for factory lighting.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Patents obtained. Patent litigation conducted, R. G. DuBois, Patent Attorney, 928-930 "F" street. Washington, D. C. Correspondence invited.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Dec. 1, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N Y City.

See illustration of improvements in Hooks for Steam Engines, in Nov. 24 issue. For particulars address T. C. Dill Machine Co., 726 Girard av., Phila., Pa.

With my System, Exhaust Steam Heating costs nothing for fuel; Live Steam Apparatus altered to Exhaust. Satisfaction guaranteed. Geo. A. Barnard, 15 Cortlandt street, New York.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N. Y.

Special facilities for the manufacturing of all kinds of light machinery, hardware and novelties, by contract or otherwise. Presswork and stamping done on short notice. Estimates furnished. Punches, dies and special tools made when required. Rockaway Mfg. Co., 3 E. 14th street, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Nov. 3, 1888 issue, 62 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 76 articles have thus far appeared up to and including the Oct. 27, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York

MANUFACTURES

H. C. Devlin will build a foundry at New Birmingham, Texas.

The Eutawville Railroad Co. will build a machine shop at Sumter, S. C.

S. R. Conger will start a sash and door manufactory at Jackson, Miss.

D. Congdon & Son will build a planing mill and a shingle mill at New Berne, N. C.

J. B. McElrath is interested in starting a saw mill and wagon factory at Centre, Ala.

The Haskell & Barker Car Co., Michigan City, Ind., will build a forge shop 130x164 feet.

The factory of the Steam Gauge and Lantern Co., Rochester, N. Y., lately burned, is being rebuilt.

The Adams Furniture and Manufacturing Co. has been incorporated, to operate at Watertown, N. Y.

All the departments of the steel plant of the Bethlehem (Pa.) Iron Company, have been put in operation.

The Rowan Knitting Co. is building a knitting factory, 42x75 feet, and engine and boiler house, at Salisbury, N. C.

The wages of the employes of the Atlantic Iron Works, at Sharon, Pa., have been voluntarily increased 10 to 15 per cent.

The F. W. Foster Manufacturing Co. are building a factory at Florence, Ala., to employ 300 hands in making builders' hardware.

The Birmingham (Ala.) Bridge and Bolt Works have been sold to H. M. Caldwell, who will put up new buildings and increase capacity.

The Springvale (Me.) Water-power Co. has been organized, with a capital of $15,000, to promote manufacturing enterprises in that town.

It is said that the Falls City Malleable Iron & Steel Co., of Louisville, Ky., will soon put in machinery to test their process for manufacturing tool steel.

The works of the Apollo (Pa.) Iron & Steel Co. are to be improved by the erection of at least one additional sheet mill, and possibly an additional steel furnace.

The Walker Manufacturing Co., Cleveland, Ohio, issue three large prints of cable railway machinery made by them. They are prepared to furnish outfits for cable railways.

Work on the Louisville & Nashville Railroad shops, at Decatur, Ala., is again in progress. It is expected that these shops, at which 1,000 men will be employed, will be finished by spring.

There is water-works agitation at Beaumont, Cal.; Toronto, Can.; Marble Falls, Tex.; Portland, Conn.; Delaware, Ohio; Scottdale, Pa.; Scranton, Pa.; The Dalles, Oregon; Stayner, Ont.; Calera, Ala.

The St. Louis (Mo.) Iron and Machine Works Company are contemplating the reconstruction and enlargement of portions of their extensive works, and also the addition of a large amount of new and improved machinery.

Harry Darlington has leased the Elba Iron & Bolt Company, limited, of Pittsburgh, Pa., and will put it in operation as soon as the necessary repairs can be made. The works were closed down in January last. Between 400 and 500 men will be given employment.

Warren Webster & Co., 491 North Third street, Philadelphia, Pa., have recently taken orders for a large number of their vacuum feed-water heater and purifier, from 40 to 1,000 horse-power. The company takes orders for this heater subject to trial of its merits.

The Vassalboro Woolen Mills, North Vassalboro, Maine, were recently sold to T. W. Walker, of Boston. It is understood that it is the intention of Mr. Walker to immediately organize a company, which will thoroughly repair the mills, put in new machinery, and operate them at an early day.

The Kenosha Manufacturing Company, Kenosha, Wis., has been organized, with a capital stock of $40,000, for the manufacture of brass utensils and novelties. G. M. Simmons is president, James Cavanagh, vice-president, and Wm. Strong, secretary. They will erect two buildings, to serve as factories, etc.

The partnership heretofore existing between W. P. Duncan, W. R. Jenkins and J. H. Lingle, trading under the firm name of W. P. Duncan & Co., has been dissolved by mutual consent, W. P. Duncan withdrawing. The business of the above firm will be conducted by W. R. Jenkins and J. H. Lingle, under the firm name of Jenkins & Lingle. They are builders of power hammers, etc., at Bellefonte, Pa.

The engineer officers of the navy have formed a society under the title of the American Society of Naval Engineers. The object is to promote knowledge of naval engineering by ways common to other engineering societies. Engineer officers are eligible to membership; also those who have been officers, and others whose knowledge of engineering is such as to enable them to co-operate.

The Reading Iron Works steam forge on North Eighth street is a busy establishment just now. A 3-ton hammer, which has not been in operation for about a year, will be started up next week. This will give employment to eight men who are now on the night turn. Four hammers will then be in full operation, with every indication that they will be kept going for months to come.—*Reading (Pa.) Times.*

The Ranken & Fritsch Foundry and Machine Company, St. Louis, Mo., have about completed the reconstruction of their erecting shop, whereby a second floor is added to it, and their steam travelers are in position and will soon be handling heavy work. Within a short while they will also have put in extensive lines of new and powerful machinery, contracted for in the East, enabling them to care all the better for the constantly increasing demand for Corliss engines, hydraulic elevators, and brick presses and general machinery with which they are now favored.

A correspondent of the *Industrial Journal* writes from Phillips, Maine: Once more this place makes a start. A. S. Wheeler and S. D. McKenney are getting material ready for putting up at once a mill for wood-working in various forms. This is a sure go, after many attempts to get a manufacturing enterprise started. Next Monday a town meeting is to be held, to see if the town will vote to exempt from taxation, for ten years, this or any other mill or manufacturing enterprise that may locate here prior to January 1, 1890. There is no doubt but that it will be done.

The Fort Payne Coal & Iron Company, of Fort Payne, Ala., has organized, with a capital of $5,000,000. The directors chosen were H. D. Goodell, Governor-elect of New Hampshire; Henry B. Pierce, of Boston; Selden Connor, ex-Governor of Maine; Joseph W. Spaulding, of Portland, Me.; F. G. Gilson, of Providence; Horatio Adams, of Boston; W. J. Cameron, president of the First National Bank of Birmingham, John B. Brodie, Birmingham, Ala.; W. P. Rice, president of the Union Investment Company, Kansas City, Mo. J. W. Spaulding was elected president. The company has bought 32,000 acres of valuable coal, iron and town site lands at Fort Payne.

Machinists' Supplies and Iron.

New York, Nov. 29, 1888.

Iron—American Pig—No change of importance has taken place since our last report, and the schedules for 1889 deliveries have not yet been announced. We quote Standard Lehigh and North River brands at $18 to $19 for No. 1 X Foundry, and $17 to $17.50; Grey Forge, $15.50 to $16.25.

Scotch Pig—We quote Coltness, $21.50; Gartsherrie, $21; Summerlee, $21.75; Eglinton, $19.25 to $19.50; Dalmellington, $20.25; Clyde, $20.50; Langloan, $20.50.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—See bottom of third column, page 11.

Wanted—By practical moulder, position as foreman of foundry. Address J. C., Am. Machinist.

Wanted—A salesman who has had experience in selling machinery. Address Box 47, Am. Machinist.

Wanted—Traveling salesmen for patented specialties in mach. shop tools. Address N, Am. Machinist.

Wanted—A competent salesman to travel for a large machine tool business. Box 50, Am. Machinist

Wanted—Foreman for a boiler shop and sheet iron works; state age, experience, etc. Address Sulzer & Vogt, Louisville, Ky.

Wanted—A first class foundry foreman for a large manufacturing establishment. Address, stating age and experience, box 49 American Machinist.

Wanted—Three first-class tool makers, accustomed to making dies and tools for small trap articles. Address Ottumwa Iron Works, Ottumwa, Iowa.

A mechanical engineer of established reputation seeks employment as manager or assistant in an engineering enterprise. Active, Am. Machinist.

First-class draftsman wanted immediately on engine design; state exp., age, ref. and salary expected. Bucyrus Foundry & Mfg. Co., Bucyrus, Ohio.

Wanted—By a pushing young man, position as foreman blacksmith, with large exp. in all kinds of stat. and mar. engines. Blacksmith, Am. Machinist.

A mechanic, familiar with English, French and German, wishes to take charge of a firm's exhibit at the Paris Exhibition, 1889. Box 48, American Machinist.

Wanted—Foreman for machine shop employing about 50 men, doing a general manufacturing and jobbing business. State age, what experience, and full particulars. Sulzer and Vogt, Louisville, Ky.

Wanted at once.—A first class machinist to take charge of and take a cash interest in a machine shop, doing a fine manufacturing and repair business in a prosperous city in northern Wisconsin. Address box 45, American Machinist.

Draftsman, young, good designer, with experience in large and small shops, quick mech'l judgment, good business ability—wants connection with small foundry and mach. shop, preferably in hands of young, enterprising man. Accept small salary and interest. References. 782 American Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Working drawings for machinery. D. J. Kelsey, M. E., 32 Ins. Bld., New Haven, Ct.

Punches, dies and special machinery built to order C. F. Langston & Co., 70 N. 4th St., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

Wanted —To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

For Sale, Cheap—A complete wire nail plant, consisting of 25 machines of the most modern construction, tumbling barrels, reels, etc. Address Sweet's Manufacturing Co., Syracuse, N. Y.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

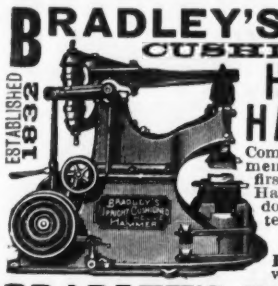
For Sale—Machine Shop and Foundry, at a bargain, in Western Ohio; business profitable; can give satisfactory reasons for selling. Address M., care American Machinist.

Tools Wanted—Steam hammer to work 6 in. iron pipe; machine to thread 6 in. pipe; power shear to cut 1¼ round iron. Good second-hand ones will do. Geo. R. Lombard & Co., Machine Work and Mill Supply Store, Augusta, Ga.

In stock and for sale, a large lot of new and second-hand engine lathes, iron planers, upright drills, shaping machines and other machine tools. Send for list and catalogue. Address Fitchburg Machine Works, manufacturers of metal working machinery, Fitchburg, Mass.

BORING AND TURNING MILLS.
LATHES PLANERS DRILL PRESSES
F. P. MICHEL ROCHESTER N.Y.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1832. Combines the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the world.

BRADLEY'S HEATING FORGES.

Established 1832. With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. For hard coal or coke. Indispensable in all shops. Pat. Aug. 30, 1887. BRADLEY & CO. SYRACUSE, N. Y. keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

98 Sudbury St., Boston, Mass.
63 Murray St., New York.

—COMPOUND—
Automatic Water Heater.

Heats water to 212°, without pressure. With pressure will heat water to 320°.

NO COST FOR FUEL. UTILIZES WASTE HEAT. NO SWEATING. NO CORROSION. SAVES FROM 15 TO 25 PER CT. OF FUEL.

The most perfect and effective Feed Water Heater ever devised.

SEND FOR CIRCULAR.

THE HUSSEY RE-HEATER
—AND—
STEAM PLANT IMPROVEMENT CO.
15 Cortlandt Street, New York.
A. S. Hatch, Pres. S. D. Brewer, Gen. Man.

$75

"Star" Foot Lathe Swings 9x25 in. Screw Cutting Automatic Cross Feed, etc.

LA LATHE H E

Scroll Saws, Circular Saws, Lathes Mortisers. Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers
810 Walnut St., Philadelphia.

☞ Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

FOR SALE. CORLISS ENGINES.

The Fishkill Landing Machine Co., located at Fishkill, on the Hudson, N. Y., offer to manufacturers and others desiring a well-built, economical and durable engine, their improved CORLISS ENGINES. They are endorsed by many reputable engineers and persons using them. Address as above.

FOR SALE CHEAP

Fly Wheel Pulley 18ft. Dia., 46" Face, 11" Bore, made in 8 Segments. Weight 32,000 lbs. In First Class Condition.

Webster, Camp & Lane Machine Co.,
AKRON, OHIO.

FOR SALE.

The following Armington & Sims Electric Light Engines, now running, to be delivered in 4 months:

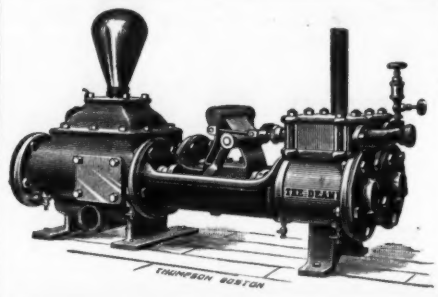
1—90 H. P. 2 Years Old.
2—60 H. P. 2 " "
4—30 H. P. 4 " "

These Engines have just been refitted with Tripp's Metallic Packing; also 4 Cunningham (steel) Boilers, 450 H. P., Jarvis Setting. Address

C. B. WATTLES, 34 Cove St., Providence, R. I.

GEO. F. BLAKE MANF'G CO
Builders of Every Variety of

95 & 97 LIBERTY ST., 111 FEDERAL ST.,
NEW YORK. BOSTON.
WATER WORKS PUMPING ENGINES A SPECIALTY



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

ENGINE LATHES.
THE HENDEY 18-INCH ENGINE LATHE

Combines modern design with superior workmanship at a moderate price. No extra charge for Compound Rest, Hollow Spindle or Power Cross Feed. Length of beds, 6, 8, 10, 12, 14 and 16 feet. Have other sizes of Lathes; also, Shapers, Planers, &c. Send for Catalogue and Prices.

THE HENDEY MACHINE CO.,
TORRINGTON, CONN.

MACHINERY STEEL CRUCIBLE or BESSEMER. HARD OR SOFT. Strong. Sound. Uniform.
MILLER, METCALF & PARKIN,
64 & 66 SO. CLINTON STREET, CHICAGO, ILLS. CRESCENT STEEL WORKS, PITTSBURGH, PA. 480 PEARL STREET, NEW YORK, N. Y.

$175.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND POWER LATHES

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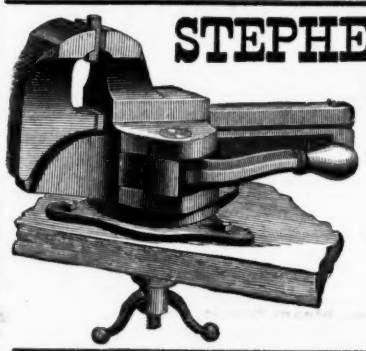

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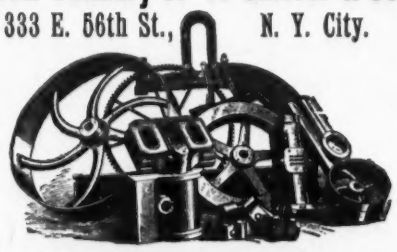

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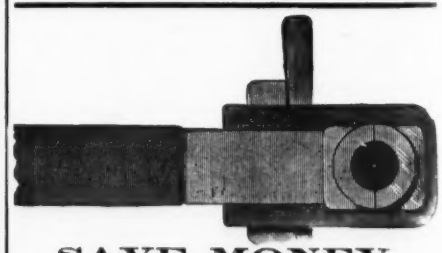

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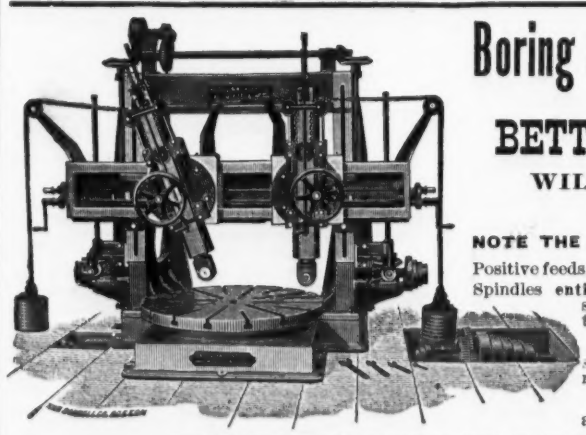

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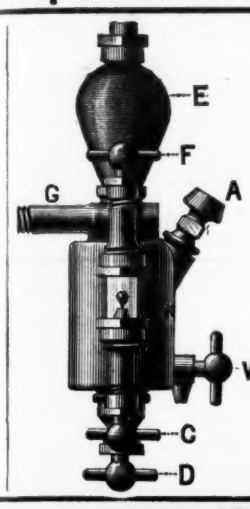

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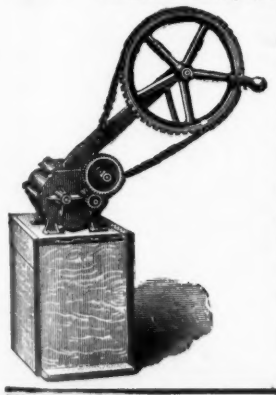

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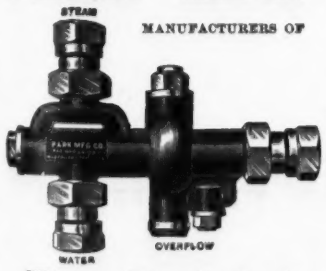

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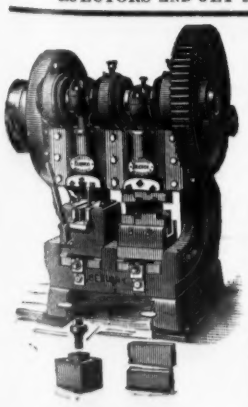

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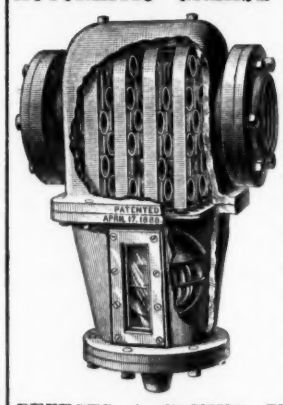

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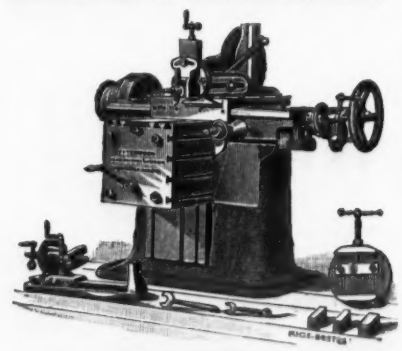

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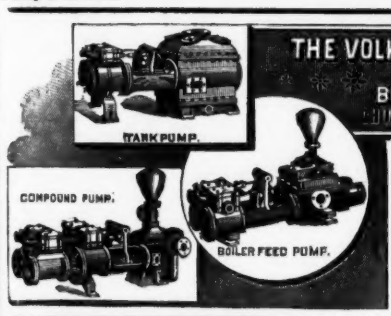

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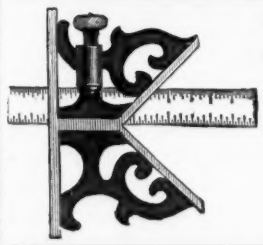

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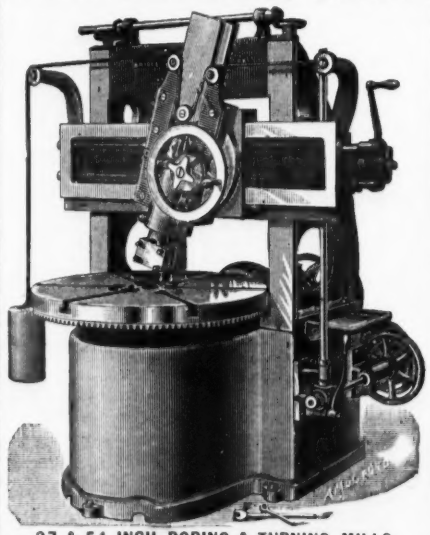

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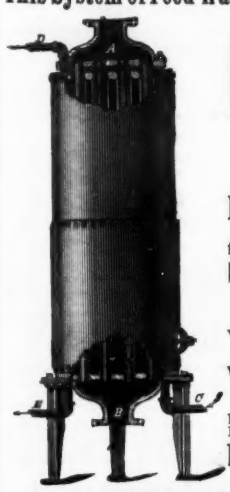

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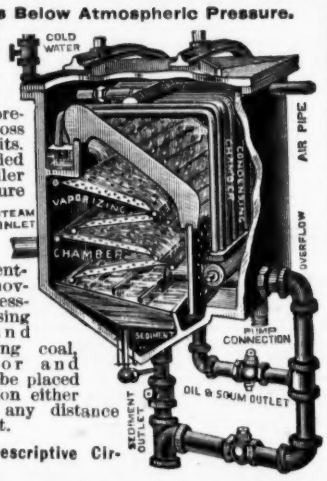

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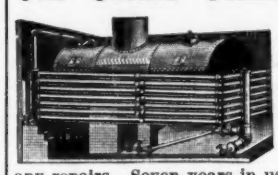

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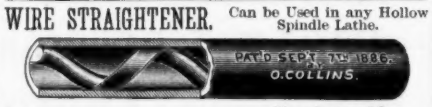

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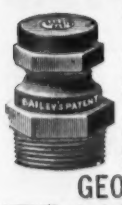

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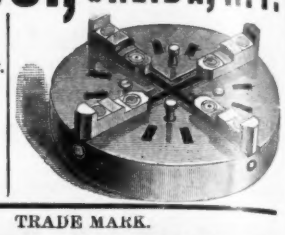

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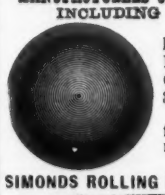

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In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.
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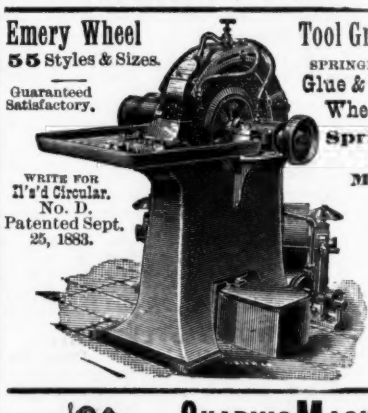

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Water Prevents HEATING THE WORK.

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6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
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THREE DESIGNS, SIX SIZES
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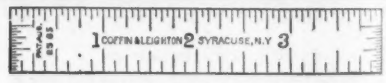

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We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
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Will bore out Locomotive Cylinders in their places by removing one or both heads, as desired, and piston. The end thrust is always in exact line with bar. It is fed with constant feed of cut gears.

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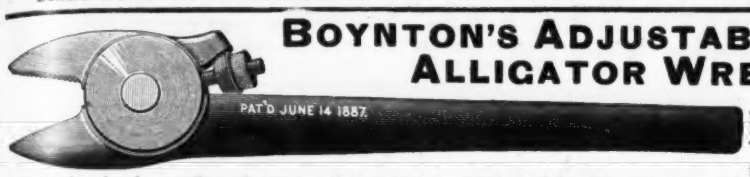

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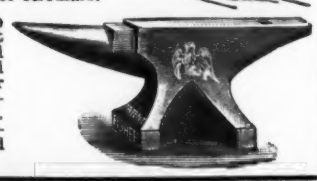

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.

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None genuine without our Trade-Mark and Name.
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
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MANUFACTURERS OF
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A portable cutting and threading machine with which one man can with ease thread pipe up to six inch diam. No vise is required.
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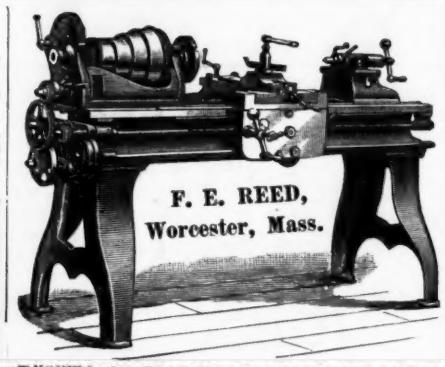

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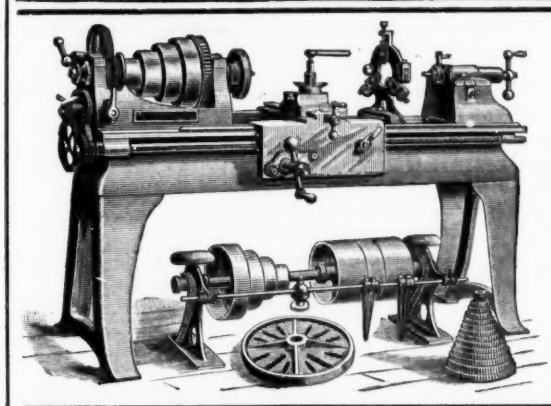


Cincinnati Centennial Exposition.

To the Committee on Rules, Jurors and Awards,
GENTLEMEN:

We, your committee appointed to make examination of Class 6, Group 41, have performed that duty, and find as follows:

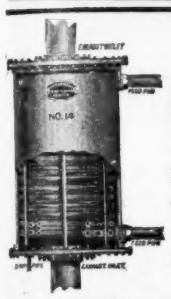
Engine Lathe; The G. A. Gray Co., Cincinnati, O. The points of excellence of this lathe over others exhibited are:

1st. Design and Proportions.
2d. Perfect contact on all plane surfaces.
3d. Change of feed.
4th. Taper and screw cutting attachments.
5th. Accuracy of workmanship and superior finish.

This lathe having shown in a number of different measurements, not only a superiority over all others examined, but a perfection seldom attained in machines of this class,

We award a Gold Medal.

D. D. MARTIN, WM. CORRY, M. L. ANDREWS, } *Jurors.*



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A brass coil Heater delivering water to the boiler at 210° Fahrenheit.

100,000 Horse Power sold. Prices Low. Satisfaction universal.

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Special facilities for Accurate Work.

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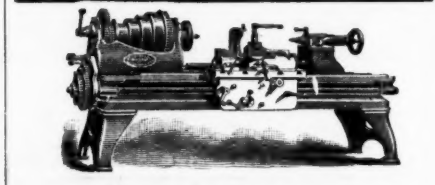

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MANUFACTURERS OF

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AND
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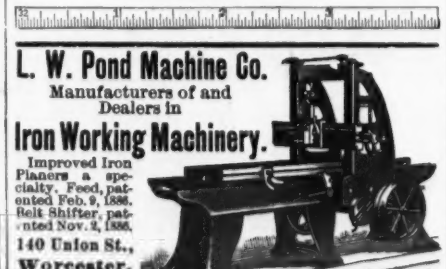
Water St., Corner Ledge,
WORCESTER, - - MASS.


L. W. Pond Machine Co.
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Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.
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BEECHER & PECK, NEW HAVEN CONN.

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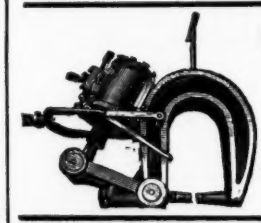

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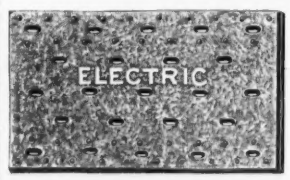

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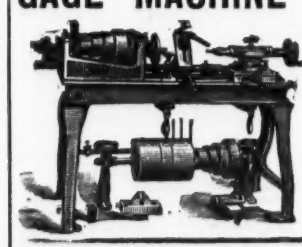

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With Saw for Cutting Metals. Saves all the broken hack saw blades. In use over two years in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each. 70c. per doz; 1 in. wide, Stubs, 35c. each. Free by mail.

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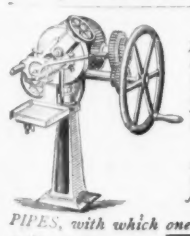

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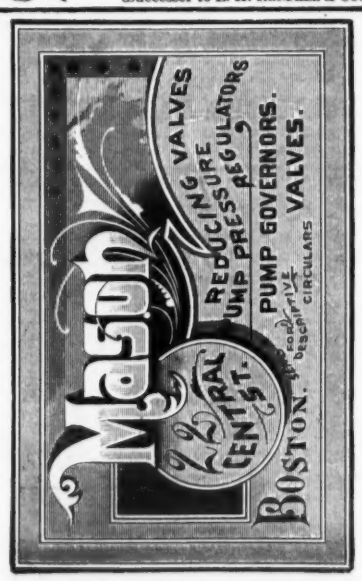

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For Chair, Furniture and Cabinet Factories, Box Shops, Planing Mills, Pattern Makers' use, etc.

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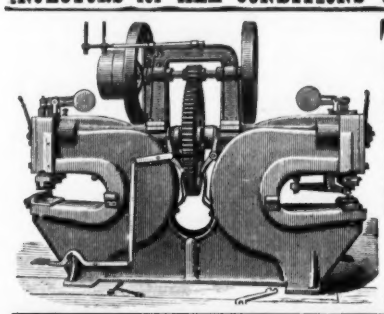

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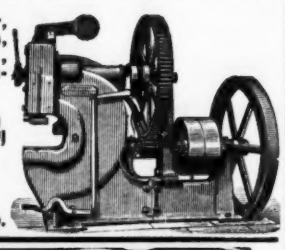

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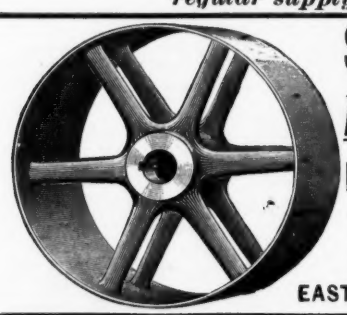

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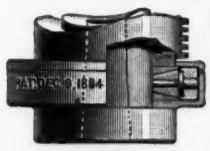

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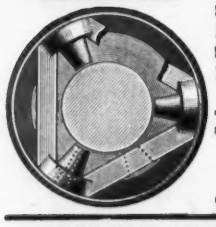

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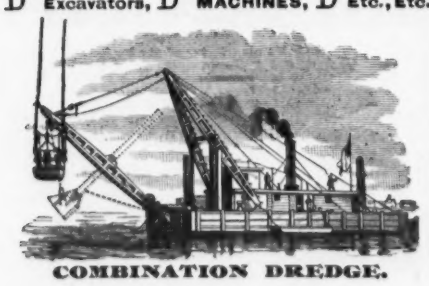

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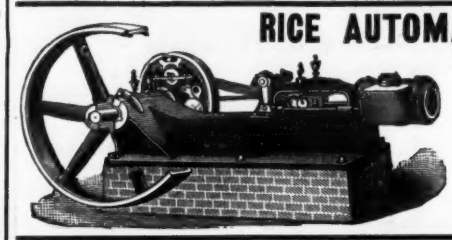

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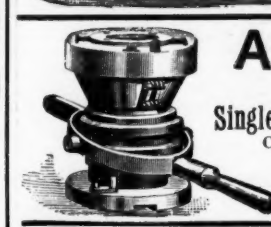

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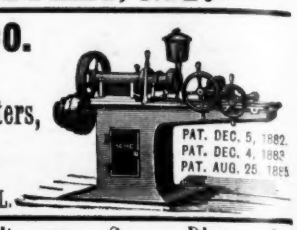

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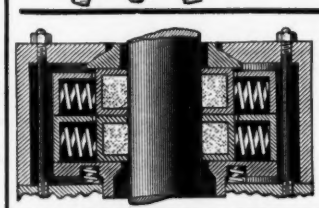

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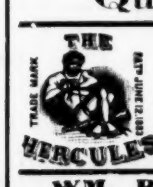

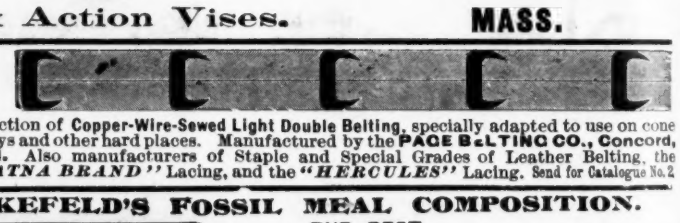

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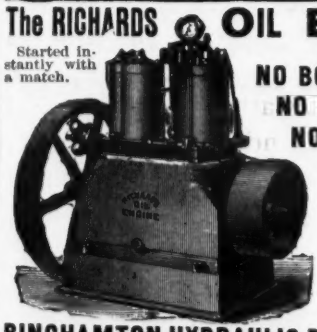
Started instantly with a match.



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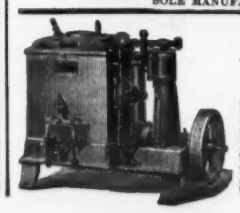

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Over 2,500 in Use.
1, 2, 4, 6, 8, & 12 Horse Power. For Farmers, Printers, M'f'rs, pumping water, sawing wood, making ice cream, etc. Mention this paper. Catalogue free.
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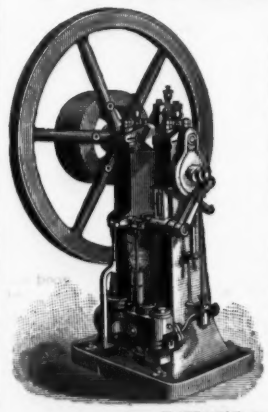
1 to 100 Horse Power.



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OVER 125 IN USE IN N. Y. CITY.
CATALOGUES on APPLICATION.
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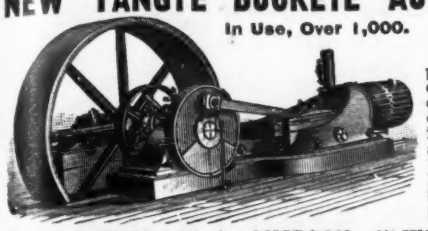

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

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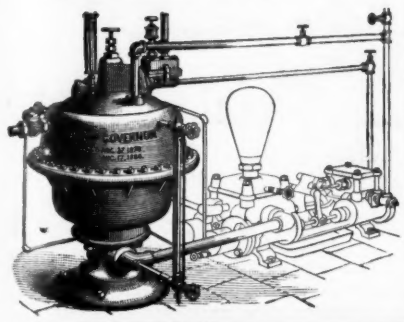

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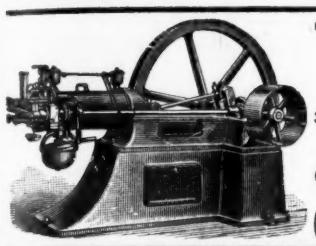

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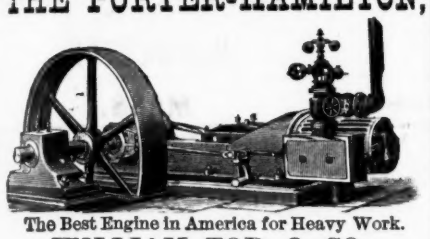

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Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

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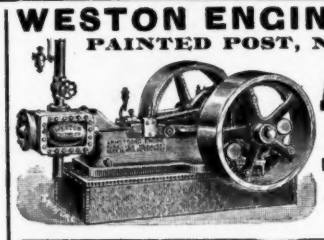

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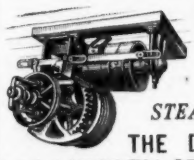

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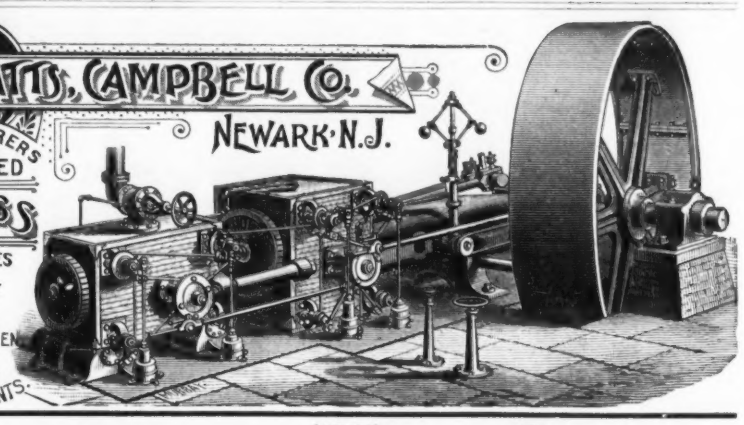

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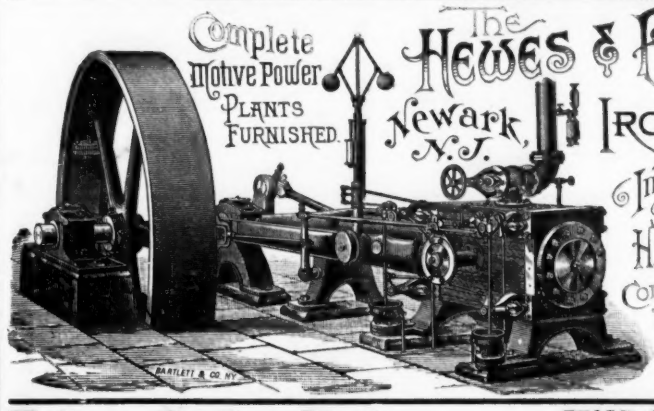

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NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

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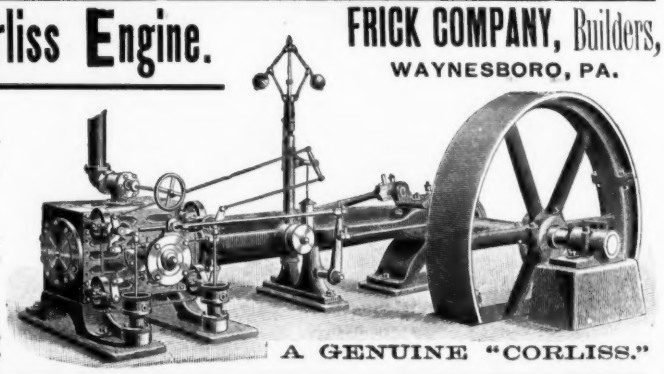

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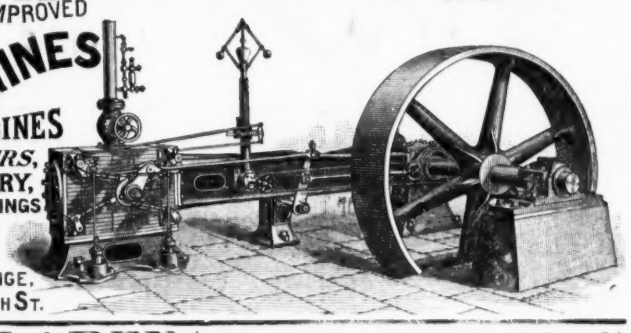

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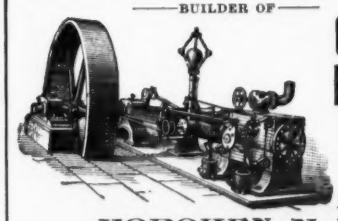

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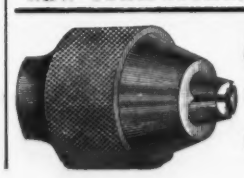

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Over 35,000 in Use.

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SECOND-HAND Iron Working Machinery.

A very large stock on hand, most of the machines taken in way of trade for new machinery.

Some of these machines are practically as good as new.

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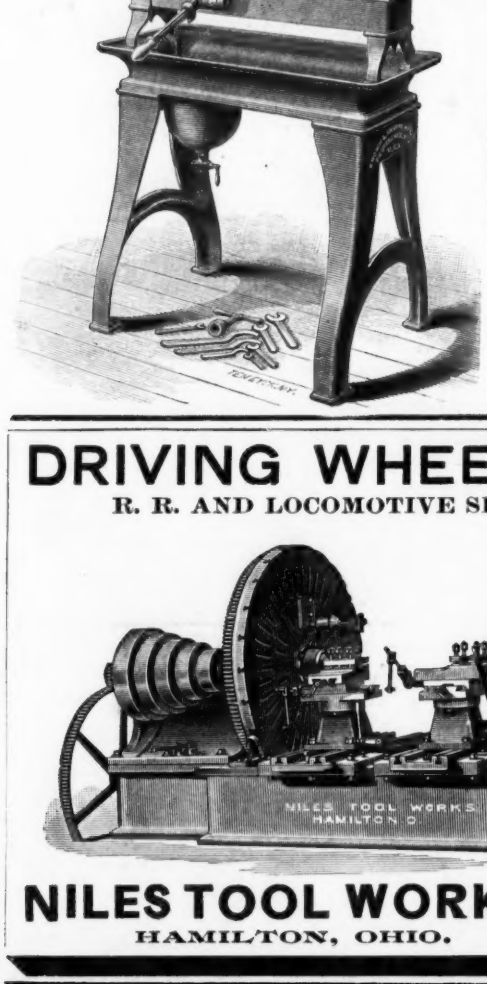

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IMPROVED SCREW MACHINE.

For Making Screws, Turning, Boring, and Facing Bushings, Tapping and Facing Nuts, Making Washers, Pins, &c.

In many instances this machine is used instead of an Engine Lathe, and effects a saving of 25% to 50% in the cost of the work.

The spindle boxes are steel, hardened and ground inside and out. The spindle is also steel: its front bearing is hardened and both bearings are ground. Size of hole through spindle, 21-32"; size of hole in revolving head, 13-16"; length that can be milled, 3½".

Illustrated Catalogue, showing full line of Screw Machines usually kept in stock, mailed on application.

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DRIVING WHEEL LATHES.

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NILES TOOL WORKS,

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CRANES

THE YALE & TOWNE MFG CO.
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The Original Unvulcanized Packing

CALLED THE STANDARD—As it is the Packing by which all others are compared.

Accept no packing as JENKINS PACKING unless stamped with our "Trade Mark."

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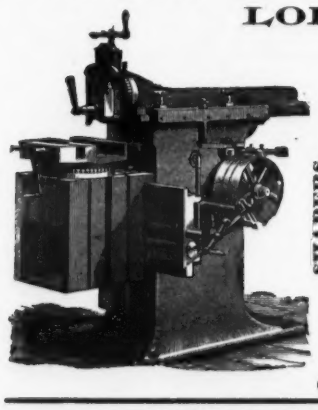
SHAPERS, ENGINE LATHES AND DRILLS

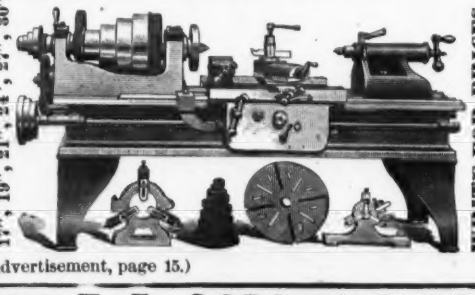
LODGE, DAVIS & CO.,

CINCINNATI, OHIO.



SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27", 30", 42".

20 inch Upright Drills. 25 inch Back Geared, and
24 " " "
28, 32 and 40 inch Power Feed Drills.



WRITE FOR PRICES, IT WILL PAY YOU.

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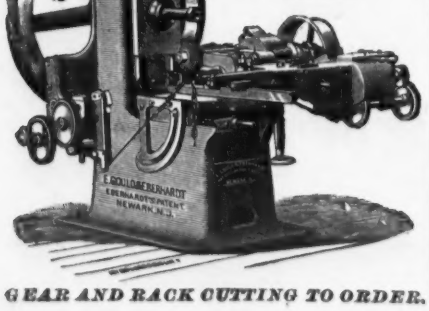
AUTOMATIC GEAR CUTTER.

18 in. 25 in. 36 in. 50 in. 60 in. 84 in. Sizes.

"Experts pronounced it the best."



GEAR AND RACK CUTTING TO ORDER.

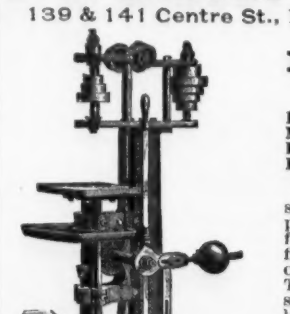
E. E. GARVIN & CO.,

139 & 141 Centre St., New York,

Manufacturers of

Machinists' Tools,

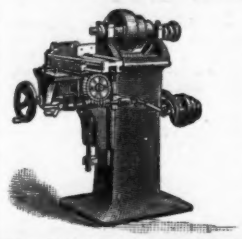
Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

THE PRATT & WHITNEY CO.

Hartford, Conn.



Manufacture Plain Milling Machines, with hand and power feed, of several sizes. Index, double face, vertical face, double spindle and shuttle race Milling Machines. Cam Cutters and Profiling Machines of several kinds. Milling Machines, Vises and Centers. Milling Cutter and Twist Drill Grinding Machines.

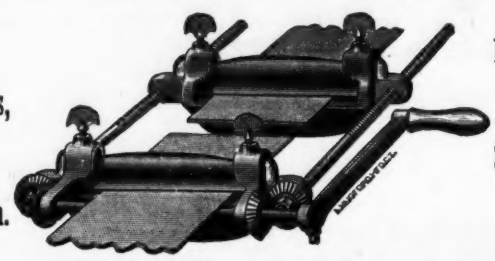
RACK AND GEAR CUTTING MACHINES.

KNURLING TOOLS. CUTTERS FOR THE TEETH OF **SPUR WHEELS.**

WESTERN BRANCH, 100 WEST WASHINGTON ST., CHICAGO, ILLS.

THE BILLINGS & SPENCER CO., Hartford, Conn.

Belt Clamps, IN Eight Sizes, FROM Eight Inch TO Thirty-six Inch.



Machinists' Tools, Sewing Machine Shuttles AND Bobbins.

DROP-FORGINGS OF EVERY DESCRIPTION.

SEND FOR CIRCULAR.

Vertical Milling Machine.

WARNER & SWASEY,

CLEVELAND, OHIO.

Machine Tools FOR Iron and Brass Work.

Send for Illustrated Catalogue.

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THE POND MACHINE TOOL COMPANY,

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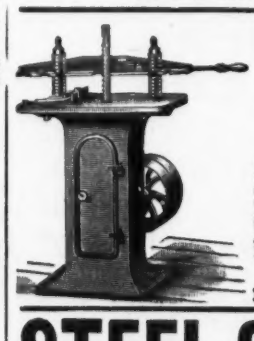

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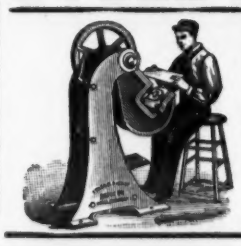

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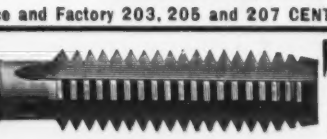

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